HSC Paging Applications With Your RC-850 Repeater Controller

The HSC radiopaging format may be used for selective call and control applications in your repeater system. It offers many advantages over other paging formats, including speed, reliability, security, and extensive capabilities. Since it's a tone rather than digital format, it's compatible with any voice transmitter with no modifications.

We'll briefly describe paging capabilities in the RC-850 controller, describe the HSC signalling format, provide details of use with the Standard PG series paging receivers and ACC's HSC tone decoder board, and look at several detailed applications in your RC-850 Repeater Controller based system.

Paging and Selective Call With the RC-850 Controller

The '850 controller can function as a paging terminal capable of generating a variety of formats. Selective call capability allows users to be available without having to constantly listen to the repeater. Users may carry paging receivers or install selective call decoders in their radios. The paging capability can also provide sophisticated, secure signalling for remote phone lines, alarms, and other control applications.

Paging tones can be commanded by users over the air, allowing user-to-user selective call. Telephone access paging allows callers to page system users. Paging tones can be included in any programmable messages, such as alarms and patch messages, allowing system initiated signalling. Messages may be scheduled as events, for periodic pager tests, net reminders, and remote scheduled control of other systems.

For simplicity, each pager is treated as a unique device. Fifty memories store information characterizing each pager, and each pager is referenced by its memory number. Selective call devices are defined by

- Signalling format
- Address ("cap-code")
- Receive frequency

The HSC signalling format and addressing information are described in this write-up. Refer to the Version 3 Programming and Operation Manuals for details on programming and activating pager memories.

What is HSC?

Hexadecimal Sequential Code (HSC) signalling is a radiopaging protocol which is an extension of five tone sequential paging. It's a one-way tone encoded signalling format which can contain address, supervisory, and data information. As an introduction, first let's see what the simpler five tone paging is all about.

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2356 Walsh Avenue, Santa Clara, California 95051
(408) 727-3330

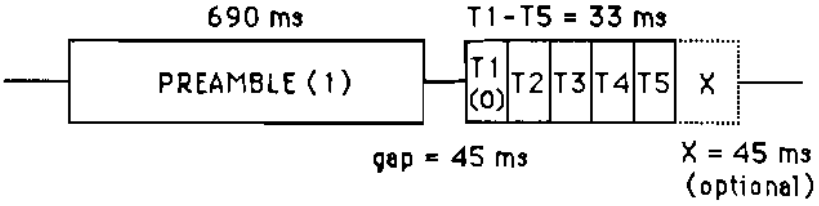
HSC Paging Applications

Five Tone Sequential

The five tone paging format consists of five short (33 ms) sequential tones with no gaps between the tones. Each of the ten tone frequencies represent a digit from 0-9. Therefore, up to 100,000 (10^5) individual units may be addressed.

In addition, an optional sixth tone in the sequence may address an alternate address, typically within the same pager unit. The sixth tone is a fixed frequency - either it's there or it isn't. An optional preamble, or wakeup tone, may preceed the five/six tone sequence. In this way, the pager receiver may be powered down most of the time, waking up briefly every half second or so to look for the wakeup tone, enhancing battery life.

5/6 TONE SEQUENTIAL TIMING



Five tone sequential paging is popular because it's fast, which means it consumes little air time, allowing heavy loading of a paging channel, and because it's reliable, has alternate address capability, and battery saving provisions. In shared voice repeater and paging applications, it has additional advantages in that it's pleasant sounding and doesn't require any modifications to the repeater transmitter, as do digital paging formats.

Its limitation is that it's a relatively "dumb" format - the address is simply sent or it's not, no data can be included, and there are no provisions for group call.

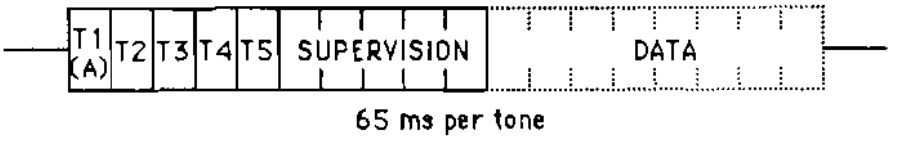
HSC - Hexadecimal Sequential Code

The HSC format extends the number of tone frequencies to 16 (hexadecimal), and the signalling is expanded from five or six sequential tones to provide additional information. Two common forms of the HSC format are available for numeric display paging and for general selective call applications. Both are supported in the RC-850 controller.

Addresses are still five digits long, but a "service block" digit is added, which allows addressing ten times as many pagers (10^6). More importantly, supervisory and data information, and provisions for multiple levels of group call are included.

HSC signalling may be mixed in a system with five/six tone sequential without either being confused by the other.

SIMPLIFIED HSC TIMING



HSC Pagers

Standard Communications and Maxon currently offer HSC format radio pagers.

The Standard PG-60 and PG-70 cover 138-174 MHz and 450-470 MHz respectively. The UHF model may be supplied by Standard with a loose crystal, which you will have to install, and the receiver will require retuning to cover 440-450 MHz, since isn't spec'd to cover the amateur band.

Maxon Electronics offers the HSC-6000 pager. Contact Maxon for further information.

Standard Communications Ordering Information – In addition to the pager frequency and five digit address, you must specify *Service Block 0*, and *Beep Period 3 seconds* for use with the '850 controller. The pager identification number is 0XXXX-Y-Z, where XXXX is your selectable portion of the five digit address, Y is service block 0, and Z is 3 seconds of alert time. A sample identification number for pager address 03900 would be 03900-0-3. **Note:** If you have questions, please contact Standard Communications or a Standard dealer.

Standard Communications Corp.
P.O. Box 92151
Los Angeles, CA 90009-2151
Telephone: 800/241-1357 (In Calif. 800/824-7766 ext. 303).

Maxon Ordering Information – Contact Maxon directly. As with the Standard PG series pagers, specify *Service Block 0*, and *Beep Period 3 seconds* for use with the '850 controller.

Maxon Electronics
10723 Ambassador Drive
Kansas City, MO 64153
Telephone: 816/891-6320

HSC Tone Decoder Board

ACC's HSC tone decoder board is available from ACC as a bare board only. It uses the MX-COM decoder chip set (in hybrid form) and provides jumper selectable decoder address, LED indicator and DPDT relay. The board may be installed inside some transceivers, or it may be mounted in a Unibox 120 or similar enclosure. The board operates from 12 volts DC at 8 mA (40 mA when relay is energized), and accepts low level audio from a receiver.

When the board is addressed, the "call" output is activated, energizing the relay and lighting the LED. The call output is deactivated by addressing the board with the "mute" tone sequence or by momentarily taking the "call reset" or "all reset" pin high.

The board's five digit address is determined by jumpers installed between the row of pins labeled "T1-T5" and the row "E1-E9". T1-5 represent tones 1-5 while E1-9 represent address digit 1-9 (an address digit of 0 uses no jumper, i.e., with no jumpers installed, the board responds to "00000").

In most cases, the jumpers can simply be wires. When a particular digit (0-9) is used in more than one position (T1-5), jumpers to that digit must be *diodes* to provide isolation with the cathode at the "T" side.

The RC-850 controller always sends the first tone as a group call digit, so "T1" may go to any pin, or may be left open as a 0. Let's examine several examples of jumper positions for various addresses.

09000	09645	09646	04458	04459	04440
T1 - open	T1 - open	T1 - open	T1 - open	T1 - open	T1 - open
T2 - E9	T2 - E9	T2 - E9	T2 - E4*	T2 - E4*	T2 - E4*
T3 - open	T3 - E6	T3 - E6*	T3 - E4*	T3 - E4*	T3 - E4*
T4 - open	T4 - E4	T4 - E4	T4 - E5	T4 - E5	T4 - E4*
T5 - open	T5 - E5	T5 - E6*	T5 - E8	T5 - E9	T5 - open

* Must be diode. Cathode (banded end) goes to T.

Designing a Code Plan

We'll develop a code plan for use on a typical repeater, which might use the HSC paging format for selective call and control applications using ACC's tone decoder board, and display pagers such as Standard's PG series. We'll organize the plan in a way that allows us to benefit from the group call capability. Any or all of each of the five address digits may be a group call digit – that is, decoders with any digit in the group call position will decode. This allows decoders to be grouped in tens, hundreds, thousands, and tens of thousands, and "all-call".

Let's assume that we have eight PG pagers in the system, one of which belongs to the repeater owner, and three others to control operators. The other four are regular users. Two of those are father and son, so we'd like to be able to "group call" them. ACC's decoder board is used at two remote phone line sites (there's also a local phone line at the repeater). Another ACC decoder board is installed at a "dumb" repeater across the valley, also owned by the same repeater owner. The '850 sends signalling tones to shut down the dumb repeater at night using the '850's event message capability.

We'll organize the pagers and decoders in groups. Since the pager format is slightly different from the decoder board format, *pagers can't be mixed with decoder boards in the same groups.*

The controller always sends the first digit as a group call digit, so that you may specify it as 0-9 (don't care).

You may become more creative in allocating address assignments to users and signalling applications, taking best advantage of group call capabilities. Just remember that any or all of the address digits may be set to "G". We'll include the assignment of the decoders and groups to pager memories.

PG Pager Organization

Address	Description	Memory	Program Command
03900	Repeater Owner	00	*2900 8 3900 0
03910	Control Operator #1	01	*2901 8 3910 0
03911	Control Operator #2	02	*2902 8 3911 0
03820	Repeater User #1	11	*2911 8 3820 0
03830	Repeater User #2	12	*2912 8 3830 0
03840	Repeater User #3	13	*2913 8 3840 0
03850	Repeater User #4	14	*2914 8 3850 0
03851	Repeater User #5	15	*2915 8 3851 0
"Groups"			
0391G	Control Operators	40	*2940 8 391* 0
039GG	Owner and Control Ops	41	*2941 8 39** 0
038GG	Repeater Users #1-5	10	*2910 8 38** 0
0385G	Repeater Users #4/5	09	*2909 8 385* 0
03GGG	All Repeater Pager Users	42	*2942 8 8*** 0

HSC Tone Decoder Board Organization

Address	Description	Memory	Prog. Command
03700	User #10	20	*2920 * 3700 0
03701	User #11	21	*2921 * 3701 0
03702	User #12	22	*2922 * 3702 0
03703	User #13	23	*2923 * 3703 0
03704	User #14	24	*2924 * 3704 0
09000	Remote Phone Line #1	50	*2950 * 9000 0
09001	Remote Phone Line #2	51	*2951 * 9001 0
09010	Remote repeater up	46	*2946 * 9010 0
09010 (mute)	Remote repeater down	47	*2947 9 9010 0
09100	Alarm indicator #1	44	*2944 * 9100 0
09101	Alarm indicator #2	45	*2945 * 9101 0
"Groups"			
0900G (mute)	Remote Phone Lines down	53	*2953 9 900* 0
0370G	All Decoder Bd. Users	25	*2925 * 370* 0

HSC Decoder Board Applications

We'll look at three applications of ACC's tone decoder board:

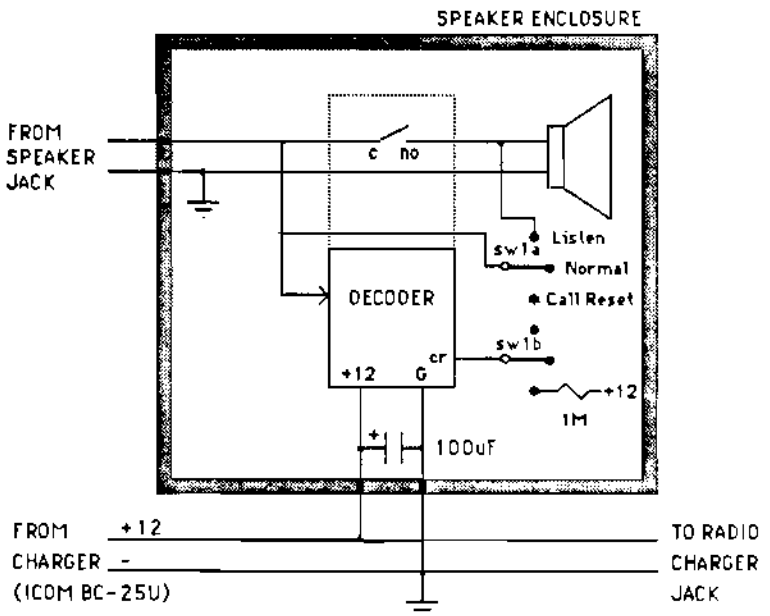
- A "Pager Speaker" which plugs into the speaker jack of your radio
- Control of a remote phone line for the '850 patch
- Scheduled on/off control of another repeater by '850 event messages

"Pager Speaker"

One of the benefits of paging capability on your repeater is that you don't have to listen to all the chatter to be available. You may want to leave the rig on at work, but can't because the chatter all day long is distracting. The HSC decoder board may be built into a speaker enclosure, which may plug into the speaker jack of your HT. When you come into work, plug your HT into the charger, and the Pager Speaker into the speaker jack. If someone needs to reach you, or if there's an emergency or a problem, your pager speaker will open and you'll be available.

The diagram for the Pager speaker is shown below. Pick any speaker which has room for the decoder board. Supply 12 volts to operate the board - you might be able to borrow it from the charger. Wire the relay in series to the speaker (common and normally open). A double pole, double throw, center off switch can be added to bypass the relay for normal listening in one position and for resetting a call in the other. The switch would best be momentary action for the call reset position.

When a user wants to reach you, they can activate your pager address as a "voice page" ([pager prefix] [pager address] *). A caller from the phone can generate a canned message through your speaker ([pager prefix] [pager address] * [0-9]). System generated pages can activate your speaker on a scheduled basis, such as for a net, or on alarm conditions - any programmable message can include paging tones to open your speaker.

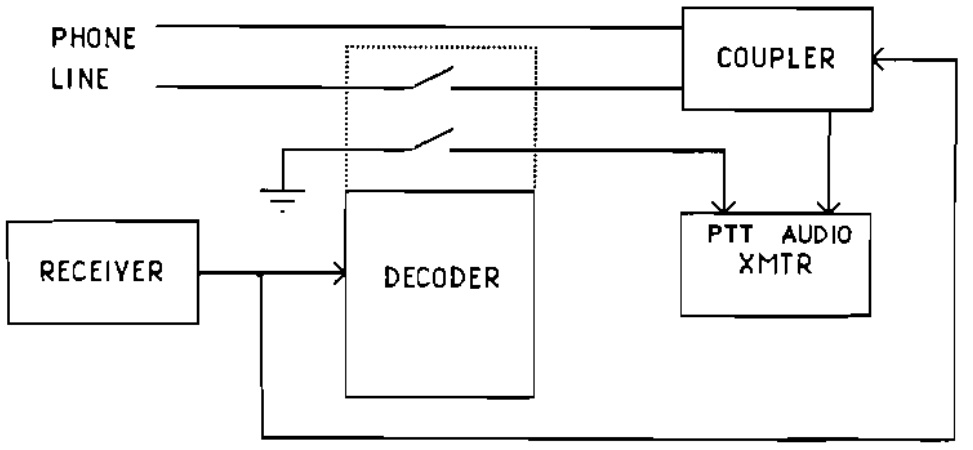


Control of Remote Phone Line For '850 Patch

The RC-850 controller supports up to three remote phone lines for use by the autopatch and autodialers. The remote sites are accessed automatically through the auxiliary (remote base) transceivers connected to the controller. Paging tones activate one of several remote sites, so that calls can be directed to an appropriate site. Auto*patch* calls are directed based on the command prefix used (primary, secondary, or tertiary prefix). Auto*dialer* calls are directed based on a prefix stored with the telephone number in the controller's memory (none or A/B/C).

When a remote phone line is activated, the controller sends signalling stored in pager memories – the three remote lines are activated through pager memories 50, 51, and 52. The remote lines are knocked down by the controller automatically sending pager memory 53 when the call is completed.

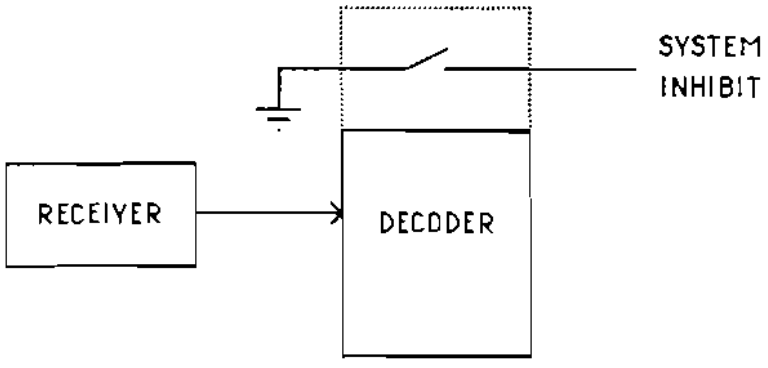
The HSC tone decoder board may be connected to the downlink reciever audio output, and when the appropriate paging tones are sent, the board activates. The relay on the decoder board may either directly switch the phone line and enable the uplink transmitter, or the decoded output may activate a half-duplex phone patch at the remote site. The actual circuitry depends on the interconnect available, but a block diagram of a typical hookup is shown below.



Scheduled On/Off Control of Another Repeater

Joe, who owns an RC-850-based repeater on Repeater Mountain, also owns a plain-vanilla repeater on Repeater Hill across Repeater Valley. It doesn't have a sophisticated control system on it yet, but Joe would like to turn it off at 11 p.m. each evening and back on at 7 a.m. each morning. His RC-850 controller can signal the other repeater, either on the repeater output frequency or on a control channel, with HSC tones to perform the function. Two Event Messages are programmed to include the appropriate pager memories and are scheduled to occur at 11 p.m. and 7 a.m.

Define Event Message #1 = [pager memory 44]
Define Event Message #2 = [pager memory 45]
Define Pager Memory 44 = HSCx, address 09010
Define Pager Memory 45 = HSCx/Mute, address 09010
Define Scheduler Event Message #1 at 7:00 a.m. everyday
Define Scheduler Event Message #2 at 11:00 p.m. everyday



MX·COM, INC.

DATA BULLETIN

MX1103QA
MX1103QC
MX1103QZ

Advance Information

HSC SELECTIVE CALLING DECODER

Features:

*Modular Hybrid Construction

*Decodes 2 to 5 Address Digits

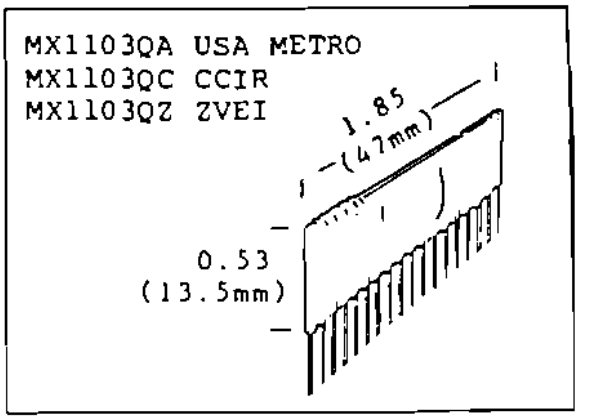
*Group-Call/All-Call Capable

*Latched "Call" Output

*Multiple Beep Alert Patterns

*Low Power CMOS

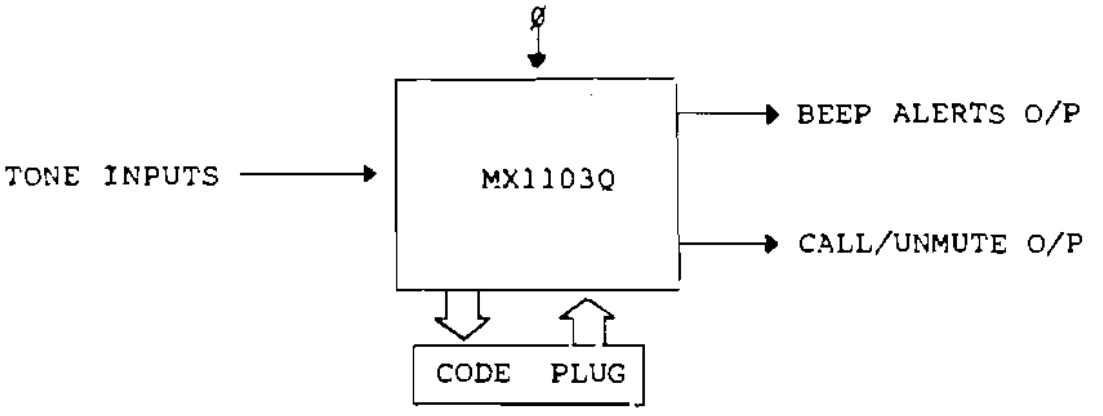
*5-Tone Sequential Reliability and Speed.



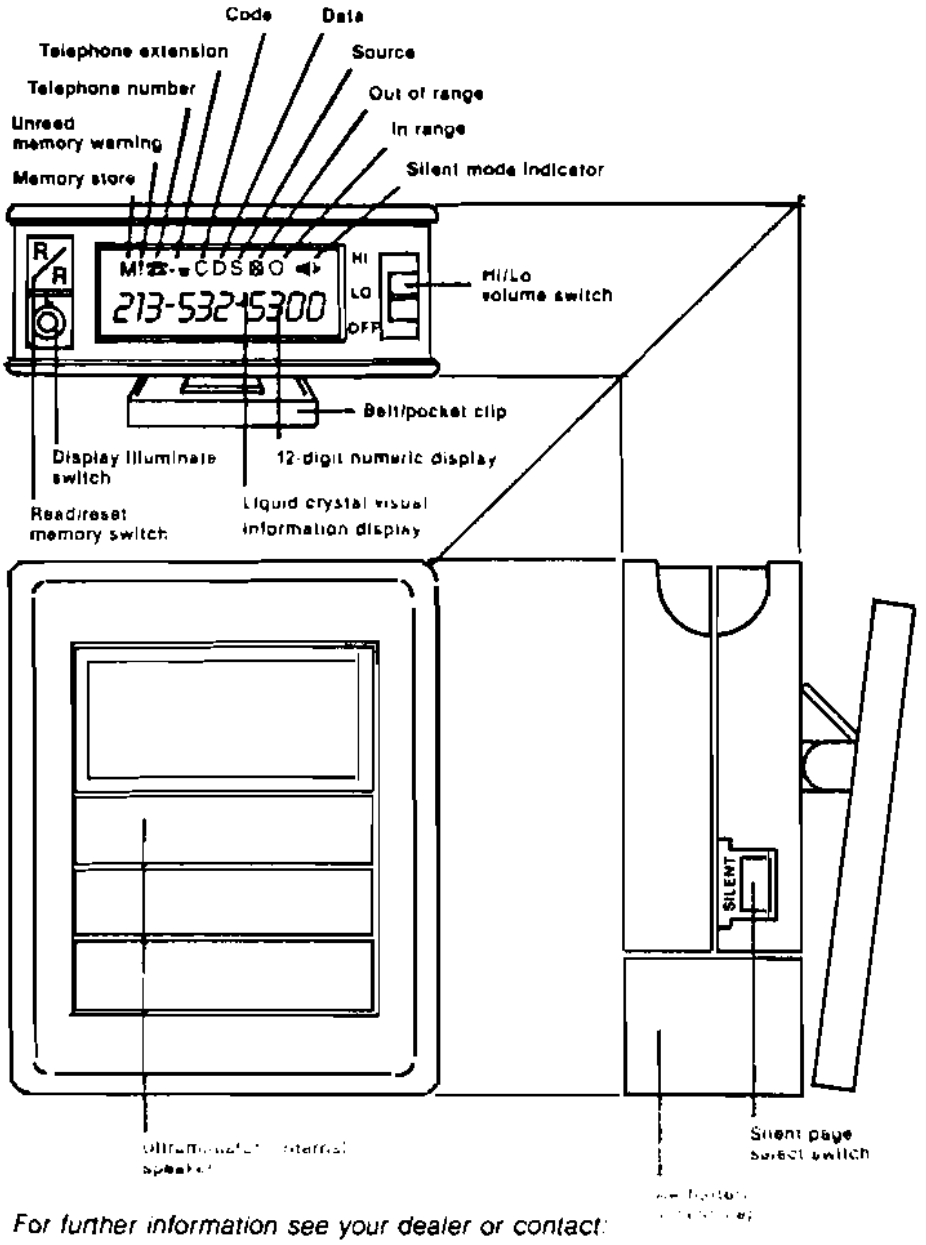
Description:

The MX1103 HSC Selective Calling Decoder processes the sequential tones comprising a coded address to output audible beep alerts and control an associated radio's speaker or "call" indicating lamp. A call reset input resets the latched output and an alert reset line cancels an active alert or recalls the beep alert of a stored call. Multiple distinctive beep alert patterns indicate the nature of three basic call types: discrete unit, alternate (emergency?), and "All" or "Group-Call" address codes. In addition, the MX1103 is able to process an instruction to cancel a previous call left in store or to mute all open speakers as a means of achieving system privacy.

External supporting components comprise a cerramic resonator (560kHz) clock circuit and a code plug (a fusible link diode matrix).



PG Series Voice/Display Pagers



For further information see your dealer or contact:

Specifications

Frequency range:

VHF (Model PG-60):	138 – 174 MHz
UHF (Model PG-70):	450 – 470 MHz
900 MHz (Model PG-90):	929 – 932 MHz

Dimensions:

Height:	2.9" (7.4 cm)
Width:	2.3" (5.9 cm)
Thickness:	0.94" (2.4 cm)
Weight:	5 oz. (28 gr) with battery

Address capacity:
1,000,000 addresses

Paging format:

5 Tone:	Hexidecimal sequential (HSC)

Group call:
10 groups & 10 sub-groups

Memory:
72 characters (6 x 12 or 3 x 24)

Sensitivity (PAGE):
VHF: 5 uV/m typical; UHF: 15 uV/m typical

Selectivity (EIA):
85 dB

Spurious & Image:
55 dB

Frequency stability:
.001% – 20 to + 50°C

Audio level:
85 dB SPL @ 12"

Operating temperature range:
– 20 to + 50°C

Case colors:
Brown (standard), Red, Blue, White, High-Tech Gray

Options & accessories:
Motor Vibrator, Custom Case Graphics, 3-Year Warranty

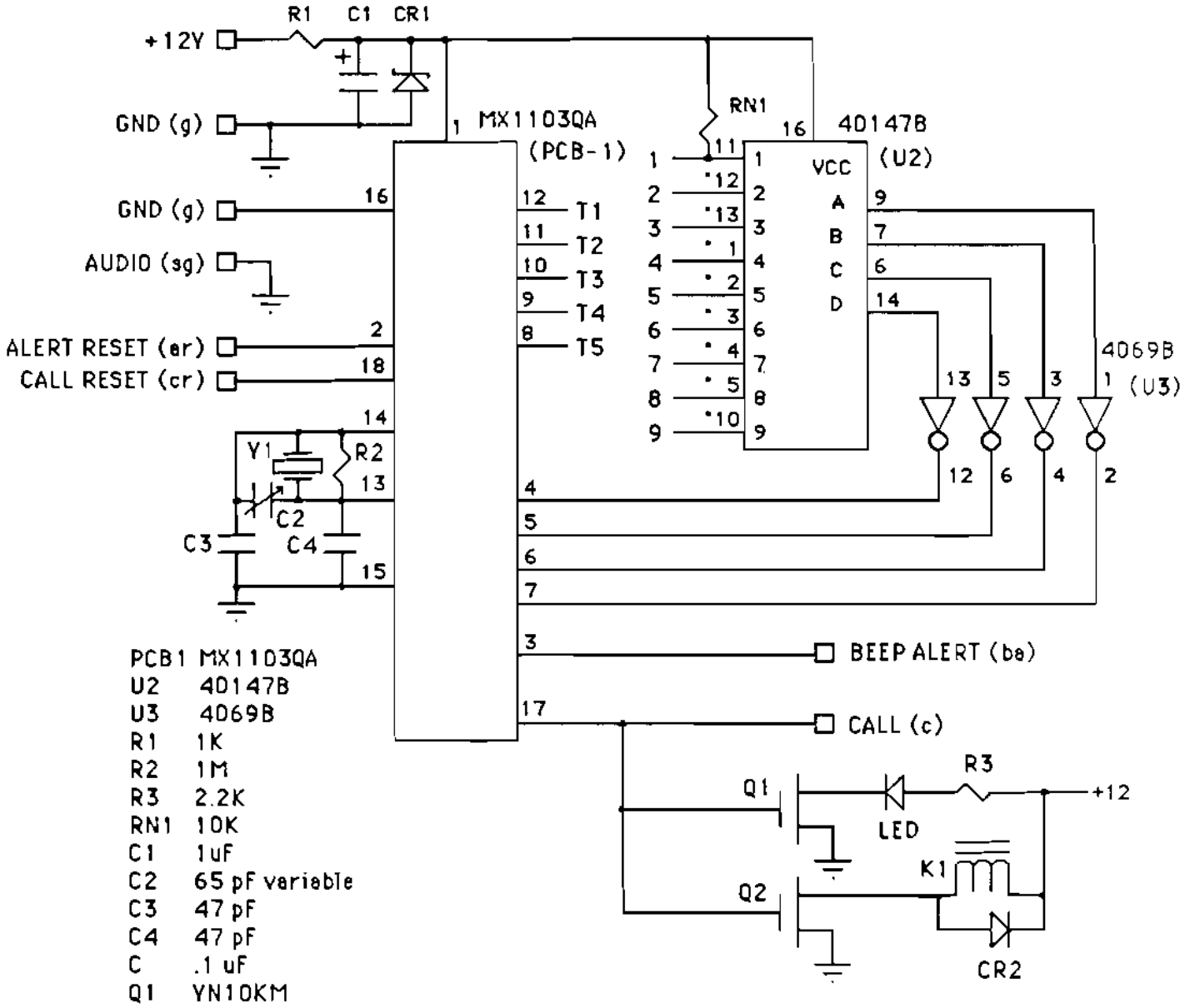
All features and specifications subject to change without notice.

Standard Communications
P.O. Box 92151
Los Angeles, CA 90009-2151
Toll-free 800/241-1357
(In Calif. 800/824-7766 ext. 303)

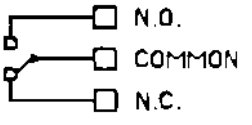
...the business radio people

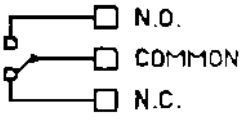
A393 1185 10Y VF

HSC Decoder Board Schematic



PCB1 MX1103QA
U2 40147B
U3 4069B
R1 1K
R2 1M
R3 2.2K
RN1 10K
C1 1uF
C2 65 pF variable
C3 47 pF
C4 47 pF
C .1 uF
Q1 YN10KM
Q2 YN10KM
CR1 3.9Y ZENER
CR2 1N4148
K1 DS RELAY
Y1 560 kHz RESONATOR
DS1 LED





MX1103QA, 560 kHz resonator, and Data Bulletin available from MX-COM, Inc. 4800 Bethania Station Rd., Winston-Salem, NC 27105 (919)744-5050
Approximate cost: $50