GORDON KAPES INC.

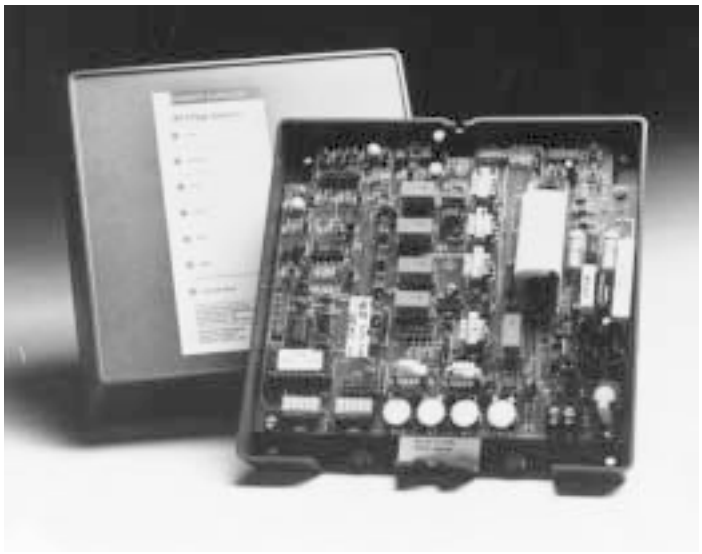
www.gkinc.com
support@gkinc.com

Technical Practice

Issue 5, February 1992

MZ-4 PAGE CONTROLLER

Contents



1. General Description

1.1 PRACTICE Several MZ-4 hardware and software changes led to a practice reissue. This revised practice applies to MZ-4 units with serial numbers MZ-4T-01400 or higher, or MZ-4C-00100 or higher. The printed circuit board has been redesigned using a CAD computer program. A trunk disconnect function has been added to the "T" version. This feature ensures that a user can never "lock up" an MZ-4T. Upon reaching the end of the page duration timer, the trunk loop current is broken, releasing the MZ-4 from the PBX. (This feature has always been present in the MZ-4C version for Centrex lines.) Associated with the trunk disconnect feature, the page length timer has been increased from two minutes to 10 minutes, better meeting user requirements. The auxiliary audio input function has been deleted as it was deemed to be confusing to implement and not terribly useful.

1.2 PRODUCT OVERVIEW The MZ-4 is designed to provide a one-way voice paging connection between a telephone system and up to four zones of a voice paging/background music system. Extensive capabilities have been implemented with hardware and software to provide a level of features, operating simplicity, and performance not found in other "page adapters."

1.3 TWO VERSIONS The MZ-4 Page Controller is manufactured in two versions. The MZ-4T is designed for connection to a PBX trunk port or key system central office (CO) line position. The MZ-4C is designed for connection to a Centrex station or standard CO loop start telephone line.

1.4 ZONE SELECTION The MZ-4 features extensive page zone selection options. Standard touch tone (DTMF) dialing signals control the MZ-4's functions. Dial pulse digits are not recognized.

Any one of the four zones or "all call" (all four zones) can be directly selected. Using simple dialing codes, any combination of the four zones can be accessed. The operating procedures were designed to be consistent and simple. In general, any incorrect dialing sequence returns an MZ-4 dial tone and allows the dialing to be started again. Much time was spent "human engineering" this device. Extensive testing by small children ensures that most adults should find the MZ-4 easy to use.

1.5 PAGE OUTPUTS The four page zone outputs are designed to directly connect to most audio amplifiers and/or amplified speakers. The output circuits use transformers to provide balanced line outputs. Transformer coupling helps to prevent hum pickup between the MZ-4 and the associated paging equipment.

1.6 TWO OPERATING MODES The MZ-4 can operate in two modes: normal and one amplifier.

Normal Mode: In the normal mode the unit is intended for connection to one audio amplifier, or group of amplified speakers per page zone. A four zone system would require four audio amplifiers, or four groups of amplified speakers.

One Amplifier Mode: In the one amplifier mode, a single audio amplifier can be used to drive up to four zones of speakers. The normal mode is superior in many ways and is the recommended operating mode. The one amplifier mode is useful in cases where equipment or budget limitations prevent using one amplifier for each of the page zones. Refer to Section 2.4 for limitation details.

1.7 ANTI-NOISE CIRCUITRY A circuit eliminates the extraneous clicks, pops, and touch tone dialing signals commonly associated with zone page adapters. The MZ-4 smoothly routes page, background music, and night tone audio to provide great sonic and operational performance.

1.8 AUDIO LEVELING An audio compressor circuit automatically adjusts the level of the page audio to ensure that all pages will be intelligible. Differences in voice levels will not interfere with page quality.

1.9 BACKGROUND MUSIC A source of background music can be connected. Switches allow the music to be routed to any or all zone outputs. During paging, the background music is muted in the appropriate zone(s). The MZ-4 contains a loudness compensation circuit to improve the sound of the background music. Most tuners, tape decks, compact disc players, or SCA music sources are compatible.

1.10 NIGHT TONE The MZ-4 contains an integral "warble tone" night tone generator. Many PBXs and Centrex systems provide a 20/30Hz ringing signal on a universal night answer (UNA) line which can be connected to the MZ-4 night tone connection. Switches allow the night tone to be routed to any or all the zone outputs. During paging, the night tone is muted in the appropriate zone(s). A control allows the installer to adjust the pitch of the night tone signal.

1.11 ZONE RELAYS Normally closed (shorted) and normally open (not shorted) relay contacts associated with each of the four page zones allow connection of a wide variety of devices. The most frequent use of the zone relay contacts are with audio amplifiers or paging systems that require a "page enable" contact closure during page for correct operation. In the MZ-4's one amplifier mode, the zone relays are used to switch the output of an audio amplifier to up to four groups of speakers.

1.12 AUXILIARY RELAY CONTACT An auxiliary relay provides a normally closed and normally open relay contact for use in a wide variety of installer implemented functions. The auxiliary relay is user controllable via standard touch tones. The auxiliary relay can be latched on or off, or momentarily enabled for eight different time intervals ranging from one second to five minutes.

1.13 PRE-PAGE ALERT TONES A single or triple pre-page alert tone is selectable on a per zone basis. An "all call" will produce alert tones only on those zones set for alert tone. The triple tone is similar in character to the pre-page alert tone heard in airports and railway stations in many parts of the world. An effective, as well as somewhat "continental" feeling is produced by selecting the triple sequence. It may remind you of the time spent in the railway stations of Paris, Rio, Calcutta, or Cleveland.

1.14 LED STATUS INDICATORS Seven LED status indicators are located on the MZ-4 circuit board and are visible with the cover on or off. These LEDs are of great assistance in determining the operating status of the MZ-4 during installation and maintenance.

1.15 CONNECTIONS All interconnections are made via a 25-pair plug and, for installer convenience, a two-position screw terminal strip.

1.16 POWERING The MZ-4 requires an external source of 24Vac or –24Vdc for operation. A 24Vac transformer is shipped with each MZ-4.

1.17 PHYSICAL DESCRIPTION The MZ-4 consists of a precision fabricated printed circuit board, and an injection molded base and cover. The thermoplastic material used for the housing conforms to industry recognized flame retardant standards. The MZ-4 measures 8.75 inches (22.2cm) square, 3.25 inches (8.3cm) deep, and weighs approximately 2 pounds (0.9kg). The MZ-4 wall mounts with four #8 screws.

1.18 FCC REGISTRATION NUMBER The MZ-4's FCC Registration Number is BVV8VH-19259-OT-N. The ringer equivalence is 1.0B.

2. Applications and Limitations

2.1 PRIMARY APPLICATION The primary application for the MZ-4 is to provide telephone access to a multi-zone paging system. The MZ-4 provides one-way voice access to four page zones. Touch tones are used to select the desired zone; pulse dialing is not recognized.

2.2 CHOOSING THE CORRECT VERSION

MZ-4T: The "T" indicates that this version is designed for use with PBX or key telephone systems. This version provides loop current back to the host system just as a CO loop start trunk would. MZ-4T dial tone is obtained by drawing loop current, i.e., the PBX or key system going off-hook. Disconnect is accomplished by the host PBX or key system going on-hook, stopping the flow of loop current.

MZ-4C: The "C" indicates that this version is designed for use with Centrex extensions, or standard loop start telephone lines. This version detects standard 20/30Hz ringing voltage, auto answers, and then provides MZ-4C dial tone. Disconnect is accomplished by the host Centrex or central office breaking loop current for at least 30mSec. The MZ-4C then goes on-hook and awaits the next ring signal. The MZ-4C is usually not appropriate for PBX station level paging; most PBXs do not break loop current upon calling party disconnect.

2.3 AUXILIARY RELAY A wide variety of devices can be controlled using the auxiliary relay codes. Accessing the MZ-4 and touch tone dialing the appropriate codes controls the auxiliary relay codes. A full form C (normally open, common, and normally closed) relay contact is available for user selected/installer implemented applications. The auxiliary relay can be latched on or off, or momentarily latched on for eight different time periods. Refer to Figure 3, Dialing Codes, for detailed dialing information. Selecting any or all zones for a voice page will not affect the status of the auxiliary relay. The auxiliary relay is intended to be a general purpose feature which can be used for many creative applications. A few

examples are opening or closing a garage door, turning on or off indoor or outdoor lighting, or sounding a factory warning tone. When a correct auxiliary relay dial sequence is received, an acknowledgment tone is sent back to the user followed by MZ-4 dial tone. The auxiliary relay function of the MZ-4 provides a cost-effective solution to the problem of direct control of a non-telephone system function, even if the MZ-4 is installed to use the auxiliary relay function only. The MZ-4 is less expensive to purchase and easier to install than products that require multiple cards, card racks, and extensive wiring.

2.4 LIMITATION — ONE AMPLIFIER MODE The MZ-4 can operate in two modes: normal and one amplifier.

Normal Mode: In the normal mode, the four zone audio outputs are intended to be connected to four audio amplifiers, or four zones of amplified speakers. In this mode, the great performance of the MZ-4, specifically the background music and night tone features, can be used.

One Amplifier Mode: In the one amplifier mode, several disadvantages arise. Since a speaker zone is connected to the amplifier only when its zone has been selected, background music or night tone cannot be provided. Also, clicks or pops may be created because the speakers are connected to the amplifier just prior to and just after each page.

2.5 LIMITATION — ZONE RELAYS A zone relay will actuate only upon a voice page to that zone. Activation of the night tone generator will not cause a zone relay to enable. It is not possible to use a zone relay to enable an amplifier during night tone activity. A zone's amplifier will have to be active at all times if night tones are to be heard over the zone's speakers.

2.6 LIMITATION — AUXILIARY RELAY Connections to the auxiliary relay contact must be chosen with the limitations of the MZ-4 in mind, particularly taking into account what could happen if power to the MZ-4 is momentarily removed. The MZ-4's microcomputer is programmed to ensure that upon power up, the auxiliary relay comes up in the off state. A momentary power failure to the MZ-4 could change the state of the auxiliary relay and activate or deactivate the connected device. The external device connected to the MZ-4 should be such that an MZ-4 power up will not cause major problems for the end user; a device such as a fire alarm is best not connected to the MZ-4.

3. Installation

3.1 WORDS OF CAUTION As with any product, installing the MZ-4 requires a safety first approach.

Warning: Never install telephone wiring during a lightning storm. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations. Never touch non-insulated telephone wires or terminals unless the telephone line has been disconnected at the network interface. Use caution when installing or modifying telephone lines.

3.2 CHECKING FOR DAMAGE The MZ-4 should be inspected for damage immediately upon receipt. A claim should be filed with the shipper if damage is found. A replacement should be ordered if necessary.

3.3 MOUNTING The MZ-4 wall mounts using four #8 pan head screws of the type appropriate for the wall material. The cover is secured by tightening the one screw on the top and the one screw on the bottom of the cover.

3.4 INTERCONNECTIONS All interconnections are made via 25-pair plug P1 and two-position terminal strip TS1. P1 mates with a cable-mounted 25-pair connector (standard to the telephone industry), supplied by the installer. Not to increase an installer's paranoia, but messed up pre-wired 25-pair connectors are found more often than one thinks. Do not be afraid of actually checking what are normally assumed to be "perfect" cables. Figure 1, MZ-4 Page Controller Connection Diagram, provides detailed connection information.

3.5 POWER CONNECTION The MZ-4 is shipped with a 24Vac transformer and a two-conductor line cord. In most cases, this power source will be used with the MZ-4. As an installer convenience, power can be connected using either plug P1 or terminal strip TS1. Power of 24Vac or –24Vdc can be connected with no straps to cut or switches to set for AC or DC operation. If amplified speakers that require –24Vdc for operation are being used in conjunction with the MZ-4, it may be possible to use the same power supply for both.

3.6 PAGE TELEPHONE LINE CONNECTIONS

MZ-4T Connection: Connect the MZ-4T to a PBX by using a trunk port set for loop start as a page port. The trunk selected must be set to pass audio in both directions. The MZ-4T returns audio tones to inform the user of page access status. The MZ-4T can connect to a 1A2 or electronic key system via a CO line position. A line button on the key telephones will act as the page access button.

MZ-4C Connection: Connect the MZ-4C to a Centrex station. The MZ-4C is accessed by dialing this Centrex station number. For correct MZ-4C disconnect, the Centrex station loop must provide a minimum 30mSec break in the loop current upon calling party disconnect.

3.7 NIGHT TONE (UNA) LINE CONNECTION The MZ-4 contains an internal night tone generator. The normal connection would be to a PBX UNA line, Centrex extension, or PBX extension designated for "night chime" operation. As the night tone generator requires 20/30Hz high voltage ringing for operation, any standard telephone line with bridged ringing will work correctly. The night tone function cannot be used when the MZ-4 is in the one amplifier mode.

3.8 BACKGROUND MUSIC (BGM) CONNECTION If desired, connect a source of background music to the BGM terminals. The input is 10k ohms, balanced, transformer coupled which will work with virtually all sources that provide a nominal line level of –10dBm. The BGM function cannot be used when the MZ-4 is in the one amplifier mode.

3.9 PAGE OUTPUT CONNECTIONS The page outputs can be connected to all types of audio amplifier line level input channels: low or high impedance, balanced or unbalanced. Do not connect the page outputs to audio amplifier microphone level input channels. Microphone level input channels expect to be connected to a very low-level microphone-type signal. Connecting a line level signal, such as provided by the MZ-4, to a microphone input will result in distorted sound being heard over the speakers. If necessary, an audio attenuator or "pad" can be used to reduce the MZ-4's output level to correctly match a microphone input. The "pad" is installed between the MZ-4 output and the microphone input. Using amplified speakers has become a popular method of providing a public address/background music system. The MZ-4's page outputs can be connected directly to up to 20 amplified speakers per

MZ-4 zone, i.e., the four zone outputs in total can connect to 80 amplified speakers. If more than 20 amplified speakers are required in any one zone, signal boosters can be obtained from manufacturers of amplified speakers.

Normal Mode: In the normal mode, the page outputs are connected to the inputs of up to four zone amplifiers, or to four groups of amplified speakers. Page output zone 1 would connect to amplifier number 1, or amplified speaker group 1. This would continue for the other zones.

One Amplifier Mode: In the one amplifier mode, page output zone 1 is connected to the line input of the one amplifier. The other three page outputs are still active and can be used for special applications.

3.10 ZONE RELAYS Normally open (not shorted) and normally closed (shorted) contacts are provided for each of the four page zones. Figure 1 refers to the normally open contacts as NO and the normally closed contacts as NC; the relay common is referred to as COM. The normally open contact closes and the normally closed contact opens whenever that zone is selected for a voice page. If "all call" is selected, the four normally open contacts close and the four normally closed contacts open.

Normal Mode: The most frequent use of the zone relay contacts is with audio amplifiers or paging systems that require a contact closure during paging for correct operation. Some paging equipment refers to this as a page enable contact.

Note: An MZ-4 limitation is that the zone relays will not close during night tone generator activity. An amplifier that requires a contact closure will not broadcast a night tone, even though night tone audio will be coming out of the selected audio outputs.

One Amplifier Mode: The MZ-4's COM and NO zone relay connections are used to switch the output of the one amplifier to the groups of speakers. The common or ground connection of the amplifier is connected to the common lead of *all* the speaker groups. The amplifier's output high or positive lead (which also may be called +25V or +70V output) is connected to all four MZ-4 relay common points: COM1, COM2, COM3, and COM4. The NO connections of the MZ-4's relay contacts are connected to the positive or high leads of the speaker groups. NO1 to speaker group 1, etc. Do not connect the output of the amplifier directly to any speakers. You must route all speakers through the relay contacts. Failure to heed this warning will lead to extraneous noise (MZ-4 dial tone, alert tones, etc.) being heard over the speakers that are directly connected to the amplifier.

3.11 AUXILIARY RELAY CONTACT An auxiliary relay is incorporated into the MZ-4, allowing a wide variety of devices to be controlled by accessing the MZ-4 and tone dialing specific codes as listed in Figure 3. Both a normally open and a normally closed relay contact are available for the installer to use. Figure 1 refers to the normally open contact as NO-AUX and the normally closed as NC-AUX; the relay common is referred to as COM-AUX.

4. Configuration and Operation

4.1 SWITCH SETTINGS The installer must set DIP-type switches SW1 and SW2 to the desired positions. Refer to Figure 2, Option Switch Selection Diagram, for detailed switch setting information.

Alert Tone Select: Switches SW1-1 through SW1-4 select which zone(s) receive the pre-page alert tone(s). An "all call" will produce alert tones only in those zones set for alert tone.

Single Or Triple Alert Tone: Switch SW1-5 selects whether the alert tone is a single tone or a sequence of three tones.

Mode Select: Switch SW1-6 selects the operating mode of the MZ-4. If the one amplifier mode is selected switch SW2-1 (BGM Zone 1) must be in the off position for correct MZ-4 operation.

Background Music Select: Switches SW2-1 through SW2-4 select which zone(s) will receive signal from the background music source. Muting of the background music during a page is done on a per zone basis. Paging to one zone mutes background music to that one zone only. Other zones with background music selected are not affected. An "all call" mutes background music to all zones.

Note: If the one amplifier mode is selected, SW2-1 must be in the off position.

Night Tone Select: Switches SW2-5 through SW2-8 select which zone(s) will receive signal from the internal night tone generator. Muting of the night tone during a page is done on a per zone basis, as is the background music muting. Paging to one zone mutes the night tone to that zone only. Other zones with night tone selected are not affected. An "all call" mutes night tone to all zones.

Note: The zone relays will not activate during night tone generation; they are only active during a voice page.

4.2 INITIAL OPERATION The MZ-4 can now be checked for initial proper operation. The power sources now should be connected and operating. Only the POWER LED should be lit. Remember, the functions of the MZ-4 are controlled only by the use of standard touch tones; dial pulses are not recognized. Continue by following the paragraph in this section that is applicable to your installation.

MZ-4T Connected to a PBX: Begin testing by using one of the PBX system's telephones to dial select the trunk that connects the PBX to the MZ-4T. The OFF-HOOK LED should light and you should hear the MZ-4 dial tone coming over the telephone's handset. The MZ-4 dial tone doesn't sound like a normal dial tone; some people have described it as a buzzing sound or a "funny noise!" Anyway, if the OFF-HOOK LED does not light, or you don't hear the MZ-4 dial tone, the connection to the trunk, or a software configuration on the PBX must be checked. A simple means of checking the MZ-4T is to connect a lineperson's handset across the MZ-4T's telephone system connection pair; WH-BL pair of Plug P1. You can draw MZ-4T dial tone by going off-hook with the lineperson's handset, and then touch tone dial selecting the page zones you want to test. The zone LEDs should light as you select the different zones. Now proceed to Section 4.3.

MZ-4T Connected to a Key System: Begin testing by using one of the key telephones to select the CO line button that connects the key system to the MZ-4T. The OFF-HOOK LED should light and you should hear the MZ-4 dial tone coming over the telephone's handset. The MZ-4 dial tone doesn't sound like a normal dial tone; some people have described it

as a buzzing sound or a "funny noise!" Anyway, if the OFF-HOOK LED does not light, or you don't hear the MZ-4 dial tone, the connection to the key system must be checked. A simple means of checking the MZ-4T is to connect a lineperson's handset across the MZ-4T's telephone system connection pair; WH-BL pair of Plug P1. You can draw MZ-4T dial tone by going off-hook with the lineperson's handset, and then touch tone dial selecting the page zones you want to test. The zone LEDs should light as you select the different zones. Now proceed to Section 4.3.

MZ-4C Connected to a Centrex Extension or a CO Telephone Line: Begin testing by using another Centrex extension, or another CO telephone line to dial the number of the extension or line that connects to the MZ-4C. Shortly after that number starts to ring the MZ-4C should answer, the OFF-HOOK LED should light, and you should hear the MZ-4 dial tone coming over the telephone's handset. The MZ-4 dial tone doesn't sound like a normal dial tone; some people have described it as a buzzing sound or a "funny noise!" Anyway, if the OFF-HOOK LED does not light, or you don't hear the MZ-4 dial tone, the connection to the MZ-4C must be checked. Once you are correctly accessing the MZ-4C, you can try touch tone dial selecting the page zones. The zone LEDs should light as you select the different zones. Now proceed to Section 4.3.

4.3 AUDIO LEVEL AND PITCH ADJUSTMENTS Three controls are provided on the MZ-4 circuit board to adjust the level of the background music, pre-page alert tone, and night tone signals. One control is provided to adjust the pitch of the night tone signal. The voice level is not adjustable and is intended to be the reference level for the other adjustments. The MZ-4 was designed to minimize the chance of sending too much or too little signal to the paging/background music system. The audio amplifier(s) and/or amplified speakers should first be adjusted for the desired level during a voice page from the MZ-4. Then adjust the background music, alert tone, and night tone levels. (In the one amplifier mode, only the alert tone control is relevant; BGM and night tone are not functional in the one amplifier mode.) This procedure ensures that the highest quality audio signals are sent to the paging amplifiers and/or amplified speakers. The control for adjusting the background music level is labeled BGM. The control for adjusting the pre-page alert tone level is labeled AT. The control for adjusting the night tone level is labeled NT.

If the night tone generator is used, the pitch control should be adjusted to give the desired night tone center frequency. Choosing a pitch different from that of the installed site's telephones can aid in discerning a night tone from that of an actual "ringing" telephone.

4.4 CONTROLLING THE MZ-4 Remember that the functions of the MZ-4 are controlled only by the use of standard touch tones. Refer to Figure 3 for the dialing codes used by the MZ-4. In general, any incorrect dialing returns an MZ-4 dial tone. At the end of any page, the user should dial "#" and then hang up. Dialing "#" disconnects the telephone line audio from all paging zones. The "#" touch tone *does not* appear in the audio output to the page zone(s). This procedure should be followed with both MZ-4 versions for the "cleanest" page audio quality. Refer to the separate MZ-4 operators guide publication for detailed operating instructions.

4.5 LED STATUS INDICATORS Seven LED status indicators are located on the MZ-4 circuit board and are visible with the cover on or off. The top LED, labeled POWER, is lit when power is coming into the MZ-4. The second LED, labeled OFF-HOOK, is lit when the page trunk port or key system CO line position (MZ-4T), or Centrex station (MZ-4C) is off-hook. LEDs three through six, labeled ZONE 1 through ZONE 4, light when that zone is selected for a page. An "all call" will light all four LEDs. The seventh LED, labeled AUXILIARY RELAY, lights when the auxiliary relay is energized. These LEDs should greatly assist in determining the operating status of the MZ-4 during installation and maintenance.

5. Circuit Description

5.1 GENERAL DESCRIPTION The circuit description is intended to familiarize you with the MZ-4 for engineering, applications, and curiosity purposes.

5.2 MICROCOMPUTER A Motorola 6805 series microcomputer (MCU) is used as the "heart" of the MZ-4. The MCU contains EPROM memory which is permanently loaded with software set to execute all MZ-4 functions. Through software and hardware design the same MCU, with the same software load, will operate an MZ-4T or an MZ-4C. In addition to EPROM memory, the MCU also contains clock, RAM memory, bidirectional port, and timer circuitry. A 3.579545 MHz color burst type crystal provides the time base for the MCU. The MCU selected is of HMOS construction which, although a power hog, is very reliable.

5.3 MCU WATCHDOG TIMERS Two separate "watchdog" timers are used to prevent the MZ-4 from "locking up," a common downside of using MCUs. Through gyrations known only to the software engineer, the program software continuously checks itself. Potential program dead ends are caught and the program continues running. A hardware watchdog monitors pulses coming out of one of the MCU I/O pins. The pulses discharge an RC circuit connected to a comparator. If the MCU "locks" due to a power glitch, static discharge, or other condition, the pulses stop, the RC circuit charges, and the state of the comparator changes. The comparator output is connected to the reset pin of the MCU, which resets and starts the MCU operating again. Credit Mitch, the consulting engineer, for suggesting the clever and highly important watchdogs.

5.4 SOFTWARE TIME-OUT DISCONNECT To prevent the MZ-4 from being accidentally (or maliciously) accessed and not disconnected from the PBX, two timer functions are implemented in software. The first timer limits MZ-4 dial tone to a maximum of 30 seconds if a touch tone digit is not received. The second timer limits a single page to 10 minutes in length. If the touch tone time period is exceeded an error tone is sent to the user, and then, for the MZ-4T, trunk loop current is broken for 2 seconds; the MZ-4C returns to the on hook state.

5.5 ALERT TONE SELECT The five alert tone select switches directly address I/O ports on the MCU. The software "reads" the switch settings to determine what sequence to take.

5.6 POWER SUPPLIES The incoming 24Vac or –24Vdc is rectified, filtered and then fed to three regulator sections containing integrated circuit type regulators. All MZ-4 versions use what is effectively 5Vdc and 10Vdc for the digital and

analog circuitry. The MZ-4T uses, in addition to the 5Vdc and 10Vdc power supplies, 18Vdc for loop current.

5.7 TRUNK/CENTREX INTERFACE Two trunk interface circuits are used, one for the "T" version and another for the "C" version. Only one circuit board is used and the appropriate parts are inserted at the factory to create the different versions.

"T" Version: A conventional battery feed circuit with a split primary, 600 ohm to 600 ohm transformer is used. Two power resistors couple 18Vdc and MZ-4 ground to the transformer center taps, and then through the transformer windings, via the loop disconnect relay contacts, to the tip and ring leads. An optocoupler detects loop current flow, sending an off-hook signal to the MCU. The secondary of the transformer is directly connected to a simple hybrid circuit.

"C" Version: A ring detection circuit bridges the tip and ring leads. Only a few parts are required to detect ring because the MCU has been "taught" how to ignore miscellaneous glitches and noise. A ring detect optocoupler ensures that isolation is achieved between tip and ring and the MZ-4 circuitry. Relay contacts are used to connect tip and ring to a split primary, 600 ohm to 600 ohm transformer. An optocoupler detects the flow of loop current, signaling the loop status to the MCU. The secondary of the transformer is directly connected to a simple hybrid circuit.

5.8 AUDIO HYBRID An audio hybrid is implemented using two sections of operational amplifier. The hybrid separates trunk interface send and receive audio. The output of the hybrid connects receive audio to the touch tone decoder and audio compressor. Dial and other progress tones are sent by the MCU to the hybrid's send audio input.

5.9 TOUCH TONE (DTMF) DECODER As pulse dialing is not recognized, all dialing commands are sent to the MCU via a one-chip touch tone decoder. The clock signal from the MCU also feeds the decoder, both as a cost savings and to eliminate the chance of two clock signals producing beat frequencies.

5.10 TONE SOURCES One I/O pin of the MCU is used as an audio source. Via software routings, it produces the MZ-4 dial, alert, error, and auxiliary relay activity acknowledgment tones. A voltage controlled amplifier integrated circuit produces the chime-type decay envelope that is heard on the alert tones. For ease of hearing, constant level audio tones are sent back to the calling party at the same time that the alert tones are sent over the page outputs.

5.11 AUDIO COMPRESSOR A voltage controlled amplifier integrated circuit is used to very effectively reduce the dynamic range of the voice input signals. This is to ensure that voice input levels from the individuals making pages will not vary greatly in output level. Someone who speaks softly has the same chance of being heard as the brute who shouts into the telephone! The compressor does not change the character of the page signal but simply evens out the level.

5.12 RELAYS Five relays, corresponding to the four zones and the auxiliary relay, provide external contacts for use in installer selected applications. An additional relay is used in the "T" version for loop disconnect, and in the "C" version for off-hook control. The relays are controlled by MCU I/O pins via a relay driver integrated circuit.

5.13 PAGE OUTPUTS Four high performance line driver circuits are used to couple MZ-4 audio to the outside world. The 5532-type operational amplifier integrated circuits directly drive 600 ohm to 600 ohm coupling transformers. This combination of parts is far from inexpensive but provides a signal that will correctly match all paging/background music systems with great fidelity. Using transformers eliminates the chance of ground hum and noise pickup possible with directly coupled, unbalanced output circuits.

5.14 BGM INPUT BUFFER A 10k ohm input impedance transformer couples the background music source to the MZ-4 circuitry. Two sections of the operational amplifier, along with a loudness compensation filter circuit act as the input buffer. The loudness filter boosts the low and high frequencies, and leaves the middle frequencies alone, increasing the perceived sound quality of the BGM output. The components and circuit design of the MZ-4 allow for true "hi-fi" BGM. Using audio compact discs (CDs) as a BGM source is encouraged!

5.15 NIGHT TONE High voltage 20/30Hz ringing signal directly connects to an integrated circuit that produces a "warble tone." Potentiometers are provided to adjust the signal level and pitch of the night tone. The warble tone is coupled to the main MZ-4 signal paths using a transformer, ensuring that ground hums or other noise on the night tone tip and ring leads do not affect the MZ-4. Analog switches mute the night tone during a voice page.

5.16 ANTI-CLICK CIRCUIT A circuit combining software-driven MCU control signals and analog integrated circuits provide the "clean" connect and disconnect operation of the MZ-4. This circuit limits the transmission of unwanted audio signals over the paging/BGM music system speakers, resulting in exceptionally smooth handling of audio by the MZ-4.

5.17 MODE SELECT One section of single pole, single throw DIP switch implements the mode select function. In the normal mode, the input to the line driver of page output 1 is controlled by one contact on relay 1. Only when the zone 1 relay is energized is alert tone and page audio directed to the line driver. In the one amplifier mode, the input to the line driver of page output zone 1 is connected to alert tone and page audio signals any time any zone relay has been selected.

6. Specifications

VERSIONS AVAILABLE
MZ-4T (Trunk Version): Intended for connection to PBX loop start trunk port or key system central office line position
MZ-4C (Centrex Version): Intended for connection to Centrex station, central office loop start line, or PBX extension meeting disconnect requirement

POWER REQUIREMENT
24Vac or –24Vdc, 300mA maximum

MZ-4T TRUNK INTERFACE PARAMETERS
Impedance: 600 ohms
Loop Supply Voltage: 18Vdc
Loop Supply Current: 32mA with 200 ohm loop, 15mA with 800 ohm loop, 52mA with shorted tip and ring
Disconnect Method: 30mSec (minimum) break in loop current

MZ-4C CENTREX STATION INTERFACE PARAMETERS
Impedance: 600 ohms
Off-hook DC Resistance: 190 ohms
Ringing Signal for Ring Trip: 40 to 150Vac RMS, 18 to 32Hz; ring detect circuit disabled for 2 seconds after ring trip
Interval for Ring Trip: Ring trip at end of first ring burst
Disconnect Method: 30mSec (minimum) break in loop current

NIGHT TONE RINGING SIGNAL REQUIREMENTS
40 to 150Vac RMS, 15.3 to 68Hz

BACKGROUND MUSIC SIGNAL
Input Level: –10dBm nominal
Input Impedance: 10k ohm, balanced, transformer coupled
Frequency Response: Complies with loudness compensation curve for optimal low level listening; 8dB broad dip centered at 800Hz nominal
Distortion (THD): 0.4% (measured at –10dBm input and output, 1kHz, BGM control set fully CW)

PAGE OUTPUT LEVELS (NOMINAL)
Voice: –10dBm normal, –2dBm maximum
Background Music: 0dBm maximum with –10dBm input, adjustable
Alert Tone: –2dBm maximum, adjustable
Night Tone: –3dBm maximum, adjustable

MZ-4 DIAL TONE
175Hz Square Wave

ALERT TONE
Single Tone Sequence: 0.6 seconds, 580Hz square wave, amplitude envelope modified to reproduce chime sound
Three Tone Sequence: 2 seconds, 290Hz, 434Hz, and 580Hz square wave, amplitude envelope modified to reproduce chime sound

NIGHT TONE
Two alternating tones, commonly referred to as a warble tone, similar in character to the ringing signal produced by some electronic telephone sets. Center frequency adjustable.

NO TOUCH TONE TIME-OUT
A time-out condition is reached if no touch tone digit is received during any 30-second period when dial tone is active. Upon reaching the end of the time period an error tone is sent to user, followed by a two-second break in loop current (MZ-4T), or a return to the on-hook state (MZ-4C).

PAGE LENGTH TIME-OUT
All pages are limited to a maximum of 10 minutes. Upon reaching the end of the time period an error tone is sent to user, followed by a two-second break in loop current (MZ-4T), or a return to the on-hook state (MZ-4C).

RELAY CONTACTS
Type: Form C (single pole double throw), break before make, bifurcated contact
Rating: 1A maximum at 30Vdc or 100Vac (resistive)

DIMENSIONS
8.75 inches high (22.2cm)
8.75 inches wide (22.2cm)
3.25 inches deep (8.3cm)

WEIGHT
Less than 2 pounds (0.9kg)

MOUNTING
Four #8 pan head screws of the type appropriate for the wall material

7. Incorrect Operation

7.1 REVIEW PRACTICE Should problems arise in the operation of the MZ-4, please review Section 3 — Installation of this practice. Ensure that all connections have been made properly. If another MZ-4 is available, substitute and retest.

7.2 LED INDICATORS The seven LED indicators located on the MZ-4 circuit board will greatly assist in locating the source of trouble. The POWER LED should always be lit. The OFF-HOOK LED will help in determining whether a functioning PBX trunk (MZ-4T) or Centrex extension (MZ-4C) is actually connected to the MZ-4. The four ZONE LEDs show the zone(s) selected to receive a page. The AUXILIARY RELAY LED shows the status of the Auxiliary Relay.

7.3 SWITCH SETTINGS See that the two DIP-type switches, SW1 and SW2, have been set for the desired functions.

7.4 ADJUSTMENTS Ensure that the three level controls and the one pitch control have been set to the desired setting.

7.5 MZ-4T TESTING A simple means of checking the MZ-4T is to connect a lineperson's handset across the MZ-4T's telephone system connection pair; WH-BL pair of Plug P1. You can draw MZ-4T dial tone by going off-hook with the lineperson's handset, and then touch tone dial selecting the page zones you want to test. The lineperson's handset will simulate the operation of a PBX trunk or key system line position.

7.6 ONE AMPLIFIER MODE OPERATION In the one amplifier mode of operation, the amplifier's output must be connected to the speakers via the MZ-4 relay contacts. No speakers can be directly connected to the amplifier output. Failure to maintain this condition will result in MZ-4 dial tone being heard over the speakers that are directly connected to the amplifier.

8. Repair and Replacement

8.1 NOT SO FAST Statistically, most equipment returned to Gordon Kapes, Inc. for repair actually has nothing wrong with it. A telephone call to Gordon Kapes, Inc. technical support can often help to get the equipment operating correctly. We don't mind spending time with our customers getting a site up and running.

8.2 SEND IT BACK If you determine that the MZ-4 is defective, return for repair or replacement according to the Gordon Kapes, Inc. Warranty/Repair and Return policy.

8.3 ONLY WE FIX IT In the event repairs are ever needed on your MZ-4, they should be performed by Gordon Kapes, Inc. or our authorized representative. For further information, contact Gordon Kapes, Inc.

9. FCC Requirements

9.1 TYPE OF SERVICE Your MZ-4 is designed to be used on standard device telephone lines. The MZ-4 connects to the telephone line by means of a standard jack called the USOC RJ21X. Connection to telephone company-provided coin service (central office implemented systems) is prohibited.

Connection to party line service is subject to state tariffs. We are certain you'll want to connect the MZ-4 to a party line, but check it out with your state first. Party, party, party!

9.2 TELEPHONE COMPANY PROCEDURES The goal of the telephone company is to provide you with the best service it can, within the constraints of receiving a good return on shareholder equity. In order to do this, it may occasionally be necessary for them to make changes in their equipment, operations, or procedures. If these changes might effect your service or the operation of your equipment, the telephone company will give you notice, in writing, possibly in advance, to allow you to make any changes necessary to maintain uninterrupted service.

If you have any questions about your telephone line, such as how many pieces of equipment you can connect to it, the telephone company will provide this information upon request.

In certain circumstances, it may be necessary for the telephone company to request information from you concerning the equipment which you have connected to your telephone line. Upon request of the telephone company, provide the FCC registration number and the ringer equivalence number (REN) of the equipment which is connected to your line; both of these items are listed on the equipment label. The sum of all of the RENs on your telephone line should be less than five in order to assure proper service from the telephone company. In some cases, a sum of five may not be usable on a given line.

9.3 IF PROBLEMS ARISE If any of your telephone equipment is not operating properly, you should immediately remove it from your telephone line, as it may cause harm to the telephone network. If the telephone company notes a problem, they may temporarily discontinue service. When practical, they will notify you in advance of this disconnection. If advance notice is not feasible, you will be notified as soon as possible. When you are notified, you will be given an opportunity to correct the problem and be informed of your right to file a complaint with the FCC. You have the right to remain silent, if you waive your right to remain silent...

Specifications and information contained in this technical practice subject to change without notice.

www.gkinc.com
support@gkinc.com

Figure 1 MZ-4 Page Controller Connection Diagram

P1 Pin Number	Wire Color	Description	
26	WH-BL	Tip	Telephone System Connection: Key System or
1	BL-WH	Ring	PBX Trunk Port (MZ-4T) or Centrex Station (MZ-4C)
27	WH-OR	Tip	Night Tone Ring Input
2	OR-WH	Ring	
28	WH-GN		
3	GN-WH		
29	WH-BR		
4	BR-WH		
30	WH-SL		
5	SL-WH		
31	RD-BL	+	Background Music Input
6	BL-RD	–	
32	RD-OR		
7	OR-RD		
33	RD-GN		
8	GN-RD		
34	RD-BR		
9	BR-RD		
35	RD-SL		
10	SL-RD		
36	BK-BL	+	Page Output Zone 1 (Page Output for One Amplifier Mode Operation)
11	BL-BK	–	
37	BK-OR	+	Page Output Zone 2
12	OR-BK	–	
38	BK-GN	+	Page Output Zone 3
13	GN-BK	–	
39	BK-BR	+	Page Output Zone 4
14	BR-BK	–	
40	BK-SL	NO1	Relay Contact Zone 1
15	SL-BK	COM1	
41	YL-BL	NC1	
16	BL-YL		
42	YL-OR	NO2	Relay Contact Zone 2
17	OR-YL	COM2	
43	YL-GN	NC2	
18	GN-YL		
44	YL-BR	NO3	Relay Contact Zone 3
19	BR-YL	COM3	
45	YL-SL	NC3	
20	SL-YL		
46	VI-BL	NO4	Relay Contact Zone 4
21	BL-VI	COM4	
47	VI-OR	NC4	
22	OR-VI		
48	VI-GN	NO-AUX	Auxiliary Relay Contact
23	GN-VI	COM-AUX	
49	VI-BR	NC-AUX	
24	BR-VI		
50	VI-SL	24Vac/GND	Power Connection
25	SL-VI	24Vac/–24Vdc	

TS1 Terminal Number	Connection
1	24Vac/GND
2	24Vac/–24Vdc

Note

NO is Normally Open (not shorted) relay contact
NC is Normally Closed (shorted) relay contact

Figure 2 Option Switch Selection Diagram

Switch	Off	On	Notes
SW1-1	OFF, Alert Tone Zone 1	ON, Alert Tone Zone 1	
SW1-2	OFF, Alert Tone Zone 2	ON, Alert Tone Zone 2	
SW1-3	OFF, Alert Tone Zone 3	ON, Alert Tone Zone 3	
SW1-4	OFF, Alert Tone Zone 4	ON, Alert Tone Zone 4	
SW1-5	Single Alert Tone	Triple Alert Tone	
SW1-6	Normal Mode	One Amplifier Mode	In one amplifier mode SW2-1 must be OFF.
SW1-7	Not Used	Not Used	
SW1-8	Not Used	Not Used	
SW2-1	OFF, BGM Zone 1	ON, BGM Zone 1	In one amplifier mode SW2-1 must be OFF.
SW2-2	OFF, BGM Zone 2	ON, BGM Zone 2	
SW2-3	OFF, BGM Zone 3	ON, BGM Zone 3	
SW2-4	OFF, BGM Zone 4	ON, BGM Zone 4	
SW2-5	OFF, Night Tone Zone 1	ON, Night Tone Zone 1	
SW2-6	OFF, Night Tone Zone 2	ON, Night Tone Zone 2	
SW2-7	OFF, Night Tone Zone 3	ON, Night Tone Zone 3	
SW2-8	OFF, Night Tone Zone 4	ON, Night Tone Zone 4	

Figure 3 Dialing Codes

Basic Dialing

Digit Dialed:	1	Selects Zone 1
	2	Selects Zone 2
	3	Selects Zone 3
	4	Selects Zone 4
	0	Selects All Call (Zones 1-4)
	#	Returns to MZ-4 Dial Tone

Extended Mode Dialing

Digits Dialed:	*XXX*	Starts and Ends Extended Mode
Two Examples of Extended Mode Dialing:		
	13	Selects Zone 1 and 3
	234	Selects Zone 2, 3, and 4

Auxiliary Relay Dialing

Digits Dialed:	*5000*	Sets Auxiliary Relay to Off State
	5001	Sets Auxiliary Relay to Latched On State
	5002	Sets Auxiliary Relay to On State for 1 second
	5003	Sets Auxiliary Relay to On State for 2 seconds
	5004	Sets Auxiliary Relay to On State for 5 seconds
	5005	Sets Auxiliary Relay to On State for 10 seconds
	5006	Sets Auxiliary Relay to On State for 30 seconds
	5007	Sets Auxiliary Relay to On State for 1 minute
	5008	Sets Auxiliary Relay to On State for 2 minutes
	5009	Sets Auxiliary Relay to On State for 5 minutes