MUSTANG
COMMUNICATIONS

MACRO SYSTEM ZONE CONTROL EQUIPMENT

INSTALLATION, COMMISSIONING & MAINTENANCE HANDBOOK

Issue No.7

SCOPE OF THIS ISSUE:

ZG/4 -black fascia units
ZG/8 -black fascia units
ZC.8 -black fascia units

Input modules
Standard options

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CE Electromagnetic compatibility (EMC) directive 89/336/EEC and amendment directive 92/31/EEC

This equipment has been designed and manufactured to the highest standards. If connected and operated as set out in this manual, there should be no Electromagnetic Compatibility problems. If any aspect of operation gives rise to concern, then please contact the manufacturer for advice.

INTRODUCTION

Thank you for purchasing this unit. We are confident that you have made a wise decision, and that you will have many years of trouble-free operation. Considerable care has been taken during the design and manufacturing processes to ensure your entire satisfaction and naturally, we would hope that the unit will perform to our design expectations, though this will be possible only if the installation is in line with professionally accepted standards and techniques.
This manual is intended, therefore, to ensure that both the installer and operator have all the necessary information to enable them to install, commission, and operate the unit in the most effective manner. We hope you will find the manual helpful, and easy to read.

The Company and its quality statement

Mustang Communications, is the manufacturing mark of equipment manufactured by Mustang Communications Limited, of Scarborough, England. The company is independent, wholly British, and dedicated to the manufacture and distribution of high-reliability, high performance public address and associated control equipment. Mustang Communications was first registered in 1966, in England.
The Company undertakes to manufacture equipment to the highest standards of workmanship and performance. Our Quality Assurance scheme operates to, or exceeds, the standards set out in British Standard BS.5750, Part 2. 1987 or European standard ISO.9002. If you have cause to doubt at any time that the manufacture, or distribution does not comply, then you are invited to write to us with your comments, which will be most welcome.
Please address your correspondence to The Engineering Director.

The **MACRO** system concept and applications

MACRO System is a comprehensive range of amplification, controls and surveillance units and associated peripherals, designed for use by emergency services and high integrity communication and alarm systems, manufactured to the highest standards of electronic and mechanical performance and with Quality Assurance to British Standard BS.5750. AC/DC equipment is designed to operate normally from 220/240V AC mains, with the capability to operate indefinitely, and without loss of any facilities, from a standby DC power source (battery system) in the event of mains failure.
Full compatibility within the **MACRO** range is assured, thus easing system design and enabling fully integrated systems to be specified using standard **MACRO** components and options.

The current manufacturing programme includes 4 and 8 output Zone Group Controllers and a simplified 8 output Zone Control. All offer AC/DC power input format with full AC and DC power integrity monitoring and indication, illuminated power switch, and a segmented bargraph VU display, and routing of a dedicated Auxiliary audio input to any of the 4 (8) output zones. There are various standard factory fitted options available.

Mechanically, MACROZone controllers utilise a robust ventilated steel casing, powder coat painted, and screen printed, with nut and bolt fastenings throughout. Connectors are tough locking DIN as standard for signals, “D” connector for auxiliary control functions, IEC mains, and military specification 97 series DC input. By use of the optional extra BRK-30 rack mount kit, the front fascia is converted tol fit a standard 3U 19" panel space.

By appropriate choice of input modules and options, the **MACRO** ZG and ZC controller range will perform with outstanding results in a multitude of applications, and a few only are listed under:-

Factory paging, time signals and alarm amplification
Retail stores paging and background music
Theatre show relay and prompt calls etc.
Multi-zone exclusive paging using one amplifier
Shopping centre automatic “spot announcements” and security paging etc.
Zoned fire alarm systems

In use the controllers will give trouble free and accurate performance, and failure or partial failure is likely to be a result of external problems with loudspeaker or input cabling etc. The following pages will provide a guide to setting up, operation and maintenance of the amplifier, but in case of difficulty it would be advisable to consult a qualified dealer or the manufacturer.

ZG/4 and ZG/8 units - general description

Both units feature a modular input section, and an output section operating at 0dB level, intended for onward amplification by **MACRO** or other power amplifiers, allocated to dedicated loudspeaker zones. The ZG/4 is fitted with 4 output modules and the ZG/8 with 8. Both feature a standard **MACRO** 8 input modular pre-amplification and priority mixing section. Refer to the block schematic of APPENDIX A
The input pre-amplifier section will accommodate up to 8 modules, selected from the comprehensive range of microphone, line input and alarm tone generator modules, shown in Table 1. These are plugged into an internal mother board system which generates 8 levels of ladder priority, equal access priority or any combination of both. Priorities may be set up easily at system commissioning stage. The module circuits feature various aspects of memory trigger, priority sinking for use with other **MACRO** zone controllers, remote relays, system busy indicators etc., and such functions are taken to a rear “D” type connector. Each input module is associated with a front panel gain control whose knob and spindle may be removed at commissioning stage and replaced by a discreet blanking plug to discourage unauthorised tampering. Line driver and stabilised low voltage PSU facilities are also on plug in modules. Treble and bass tone, and master gain adjustments are internal and pre-settable.
The line output section consists of four (or eight) plug-in line driver modules associated with a separate mother PCB. Input circuitry is provided on each module for 3 independent audio signals: a priority signal; a non-priority auxiliary signal; and thirdly, a reserved signal, for line surveillance use. The first priority signal bus is internally linked to the resultant priority output from the mixing pre-amplification stage at 0dB level. The second input of each module is connected to an associated front panel Auxiliary Input zone selector switch bank whose combined input is taken from a rear mounted Auxiliary Audio input socket for signals such as music, noise conditioning, etc. Thus music, for example, may be allocated to any combination of zones at any time as required. The third input is dedicated to the 20kHz line surveillance signal which is generated on the mother PCB.

In use the ZG unit is configured such that the various current sinks associated with the individual (or all) channels of the mixer pre-amplifier section which terminate on the rear Auxiliary Output connector, are connected to the Auxiliary Input socket - either directly or via a switching system as would be found in a selective zone paging microphone for example. The general concept is illustrated in Fig. 9 on page 18, and in APPENDIX C

Each of the Auxiliary Input control lines is associated with a PCB mounted zone group pre-selection switch bank, each of which has 8 switch poles. Each pole is assigned to one of the output modules, thus providing the opportunity of group control. Additionally a further Auxiliary Input connection is linked to all output modules simultaneously for 'All-call' purposes. The ZG/4 features 4 pre-selection groups, whilst the ZG/8 has 8.
The non-priority audio input of each output module is normally 'on'. Operation of an Auxiliary Input control line will cause the pre-selected group of module priority circuits to be enabled, whilst disabling the non-priority inputs and operating associated current sinks. The third input remains uneffected. Thus, the operation of one of the mixer section priorities and hence its current sink, can be arranged in turn, by means of a paging microphone switch for example, to operate in turn any pre-set group of zone line output circuits. Any auxiliary audio input (for example music) to those zones will be smoothly faded out for the duration, though the music to other zones will be uneffected.

The audio sensitivities of each of the two inputs to each output module are independently adjustable on the module.
The continuous surveillance signal through the module is maintained, in order that the associated amplification may be monitored irrespective of the mixer pre-amplifier settings, tone controls etc.

All the Auxiliary Output and Auxiliary Input lines are diode isolated to enable any combination of matrixing required, without compromise. **MACRO** microphone bases are also diode isolated so that Auxiliary Input control signals may be taken simultaneously from various microphone bases. Only upon a particular microphone gaining priority access - and hence a corresponding earth sink return from the mixer, will any output module (or group of modules) be triggered.
The incorporation of audio activated (VOX) input modules enables the automatic selection of output groups or zones without any switch selection.
The priority audio level feed to the from the mixer pre-amplifier section to the modular line output section is monitored by a front panel bargraph. There is no facility to monitor individual line outputs directly.

ZC.8 - general description
The ZC.8 zone control is a conventional form of zone controller, operating at 0dB level, with 8 output modules and mother board. Neither the mixer pre-amplification, nor pre-selector switches are featured. Two levels of priority are fitted to the output modules, as with the zone group controllers above, for priority and non-priority auxiliary audio signals. A third input is for the injection of line surveillance signals generated on the mother board. Operation, control and adjustment of these signals is as per the ZG controllers above. The front bargraph indicates the priority audio input level at the mixer facility socket.

GENERAL SPECIFICATIONS: ZG/4 & ZG/8

	ZG/4	**ZG/8**
Input channels	Up to 8 standard **MACRO** input modules - see page 8	
Mixer frequency resp.	Dependent upon input module fitted	
Priority chain	8 levels: Ladder, equal access or any combination	
Control outputs from pre-amp section	250mA current sink from each accessed module, and 'ANY'	
Treble & bass adjustment	± 12 dB @ 100Hz and 10kHz, ref: 1kHz. Overall	
Other audio adjustments	Internal master gain. Overall operation	
Mixer facility audio out	775mV RMS - 0dB unbalanced. Pre & post master	
Auxiliary Input audio	100mV - 775mV @ approx. 22k ohms unbalanced	
Auxiliary frequency resp.	20Hz - 20kHz ± 3dB	
Zone audio outputs	775mV RMS - 0dB unbalanced (factory option-balanced)	
Output zone groups	4 groups & all	8 groups & all
Controls to output section	One control for each group, and one for 'All Zone'	
Control outputs	250mA current sink from each accessed zone	
Auxilliary DC output	nominally +24V fused F1A. Surge to +35V unloaded	
Zone adjustments	Priority sensitivity, and non-priority sensitivity	
User controls	8 input gains, zone Auxiliary input selector, power	
AC Power requirements	220/240V AC 50-60Hz 10VA	
DC Power requirements	24V (22-28V) DC @ approx. 400 mA (module dependent)	
Alarm outputs	AC fail, DC fail. Contacts 'open' when unpowered	

GENERAL SPECIFICATION: ZC.8

Priority Audio input	100mV - 775mV @ 22k ohms approx. unbalanced
Auxiliary Input audio	100mV - 775mV @ 22k ohms approx. unbalanced
Frequency response	20Hz - 20kHz ± 3dB
Zone audio outputs	775mV RMS - 0dB unbalanced (factory option-balanced)
Control inputs	One control for each group, and one for 'All Zone'
Control outputs	250mA current sink from each accessed zone
Auxilliary DC output	nominally +24V fused F1A. Surges to +35V unloaded
Zone adjustments	Priority, and Auxiliary Audio sensitivities
User controls	Zone Auxiliary Input selector, power
AC Power requirements	220/240V AC 50-60Hz 5VA
DC Power requirements	24V (22-28V) DC @ approx. 150 mA
Alarm outputs	AC fail, DC fail. Contacts 'open' when unpowered

FRONT PANEL CONTROLS & INDICATORS

By design, user accessible controls are kept to a minimum to avoid inadvertent maladjustment which could render the system ineffective. Each input channel of a **MACRO** Zone Group Controller may be adjusted for gain by using the front panel controls. Should the commissioning engineer deem it prudent, he may remove any of the complete control knob/spindle assemblies, after adjustment is complete, simply by pulling the knob. The resulting holes may then be blanked off using the blanking plugs supplied. The controls may be refitted at any time subsequently.
Either 4 or 8 Auxiliary music selection switches are associated with the rear Auxiliary audio input connector. This audio signal may be directed to any combination of output zones as required.
The illuminated power switch controls AC and DC power input simultaneously.
Two systems of LED indicators provide a simple means of assuring the user of correct operation.
A 10 segment LED ladder gives an indication of the priority audio level between the mixer facility socket and the line output section, expressed in decibels - i.e. dB relative to maximum output amplitude. Under normal program conditions this will fluctuate between the extreme left and extreme right segments in accordance with the amplitude of the program at any particular instant. No segment is illuminated when the unit output is zero. If the illuminated segment is predominantly to the extreme right (maximum) then it is likely that the unit is being over-driven and that the resulting sound could be distorted on peaks. Reduce the corresponding front input gain control accordingly. The indicator is influenced by the Master Gain control adjuster of ZG units - a low master setting will give a low bargraph indication.
A fast attack/slow decay circuit is used to drive the display so that amplitude peaks are recognised.
A multi-colour LED indicates the status of the power supply in use. For further details see page 21.

TONE CONTROL & MASTER GAIN ADJUSTMENT - ZG units only

Tone control facilities are provided on the line driver module, type TB.6 which is located at second right when viewed from the front. Two trimmer potentiometers are located at the bottom of the module, just above the edge connection tabs. Viewed from the front, the nearest is the bass adjustment and the furthest is the treble. Each controls a cut & lift correction circuit with the central position of the rotator giving nominally flat response. At the extremities of rotation, the corrections are ± 12dB at 100Hz and 10kHz respectively. Rotate controls

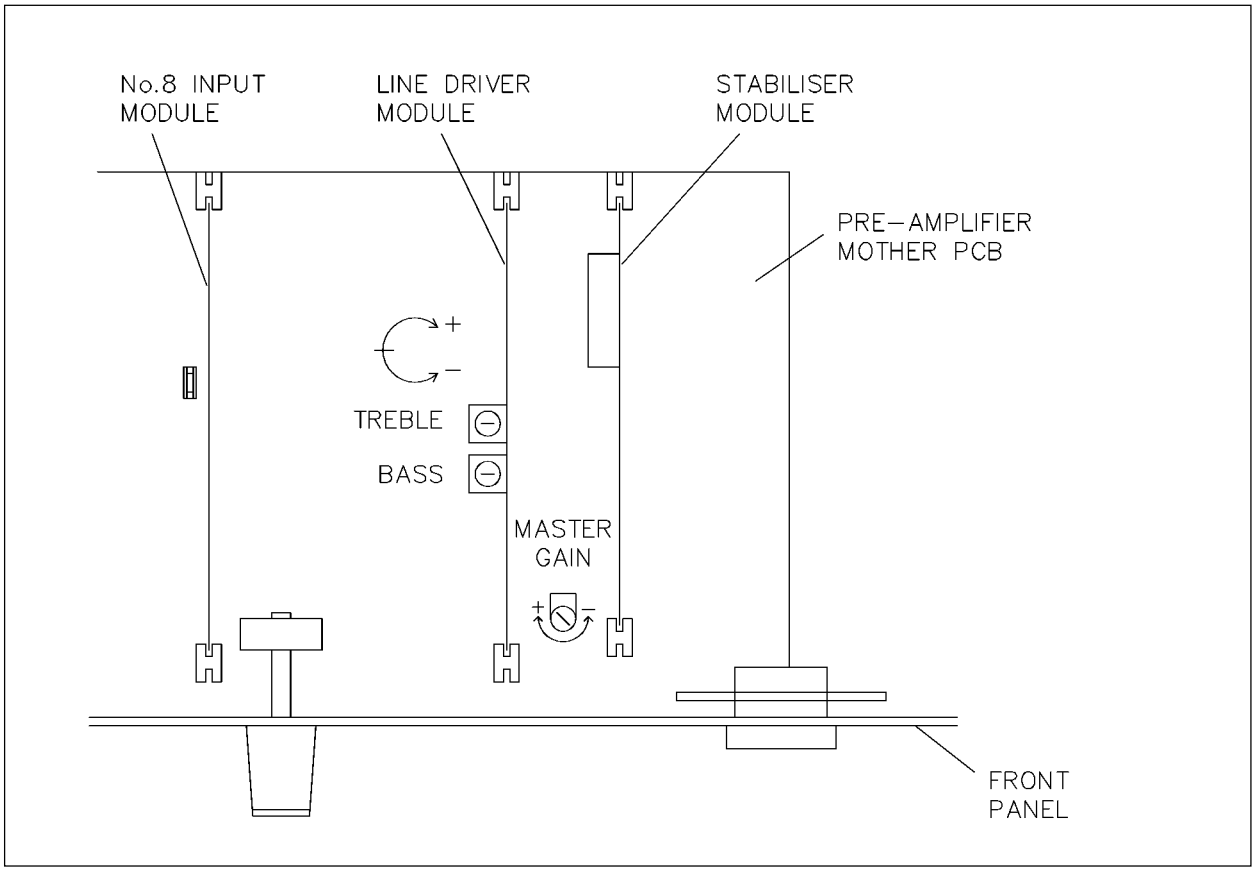


Fig. 1 Location of Treble, Bass, and Master gain controls - ZG units

clockwise to increase the gain at bass or treble frequencies. On leaving the factory, the controls will be set for level response. See Fig. 1
A conventional master level control is featured on the mother PCB between the line driver module (TB.6 etc) and the pre-amplifier stabiliser module (PS.92 etc.) next to it. This control is set to maximum (fully clockwise) on leaving the factory. See Fig. 1

INPUT MODULE SYSTEM - ZG units only

The general accent of **MACRO** system amplification is towards flexibility of system design. Each **MACRO** Zone Group Controller will accommodate up to 8 purpose designed input modules selected from over 30 variations of pre-amplifiers, tone signal and alarm generators. Any of the priority modules from the published list may be used in any of the 8 input channels of the controllers.

SYSTEM DESIGN NOTE: It must be remembered, that due to the prioritised configuration of both the input and output sections of a zone controller, it is not be possible to provide music/non-priority audio signals from the mixer pre-amplifier section under normal circumstances. Each output zone must be specifically accessed to enable signals to be passed through from the pre-amplifier section.
Normal music or other non-priority audio signals necessitate the signal being taken specifically to the dedicated Auxiliary Audio input connector at the rear, from an external source. Such signals are not available from the pre-amplifier section without interference by the priority circuit operation.

Modules are available to generate various alarm tones, and to accept priority audio input signals for low-level processing from all known audio sources. Depending on type, each module may be given a priority within the unit as described below. The chosen group of modules is set up within the unit by the commissioning engineer to exhibit the required sequence of priorities for the specific sound system, and further individually adjusted on the module for sensitivity, tone frequency, etc. These system adjustments are not directly accessible to the user, who is confined to the front panel controls. Modules may be changed, removed, or adjusted at any time without disturbance to the general operation of the system. Where priority sinking is featured, two alternative sinks are offered simultaneously - "Any" priority, and "Individual input" priority. Therefore, the control circuits of the output section of the controller may be triggered by the input module sinks to respond to certain dedicated input access conditions. These interconnections may be taken via manual controls to greatly expand the flexibility of the control system.
A "Chime Duration Monitor" sink, where fitted, gives "clearance-to-speak" information for paging systems via the "CDM" current sink connection of the auxiliary output. Priority sinks and "CDM" current sinks operate independently of each other. The general concepts of the current sinks, interconnections, etc., are illustrated in APPENDIX C, and Fig. 7 on page 17.

Module installation
MACRO range Zone Group Controllers are intended for permanent installation, and consequently the plug-in concept of the modules does not anticipate continuous or regular changing of modules. Whilst this is possible, the edge connector contacts will wear prematurely and become intermittent and unreliable. Modules are located between vertical supports immediately behind the respective front panel volume control, and only moderate force will be required when fitting or removing. DO NOT put pressure on the components during this operation.

Module range
The range of input modules extends to cover all common functions for **MACRO** amplifiers and zone group controllers. The current range is shown below

MICROPHONE & LINE INPUT MODULES

M240	Universal low impedance microphone input, transformer balanced, and phantom supply.
M260	Low impedance transformer balanced microphone input with chimes and phantom supply.
M280	Low impedance transformer balanced microphone input, audio operated priority, and phantom supply.
L240	Universal line input, transformer balanced, 50mV - 100V
L270	Universal line input, transformer balanced, 50mV - 100V, chimes.
L300	Universal line input, transformer balanced, 50mv - 100V, audio activated priority.
L330	Auxiliary unbalanced line input, 75mV- 2.0V, priority/passive
L340	Auxiliary unbalanced line input, 75mV - 2.0V, priority, chimes (no CDM)

NON-PRIORITY MODULES

E260	RIAA equalised 5mV @ 50K for magnetic phono cartridge Flat response, 80mV to 1V for ceramic phone cartridge

TONE GENERATOR MODULES

T260	Repeating gongs with timer, priority hold & memory
T270	Multi function alarm tone generator. Provides dee-dah, whoop, warble, time pips, dashes, and continuous. Momentary triggering or with timer, priority hold & trigger memory.
T300	Trimphone telephone simulator, momentary triggering
T320	Triple chimes with timer, priority hold, & memory

Table 1 The current range of input modules

MICROPHONE & LINE INPUT MODULES ** see system design note on page 8
Module features & general specifications & DIL switch settings

MICROPHONE INPUT MODULES	M240	M260	M280
Transformer or Electronic balanced	T	T	T
Priority only or priority/passive option	PP	PO	PO
Priority controlled current sink	✔	✔	✔
Chimes & Chime Duration Monitor sink		✔	
Phantom DC supply	✔	✔	✔
Audio activated priority (VOX)			✔
Bass cut facility	✔	✔	✔

GENERAL SPECIFICATIONS - MICROPHONE INPUT MODULES

Input mode	Transformer balanced, centre tap by-passed to Audio 0V
Sensitivity range	100uV to 100mV
Input impedance	Suitable for 200 ohm microphones
Frequency response -3dB points ref 1kHz	60Hz - 20kHz
Bass cut response	-3dB @ 300Hz -6dB @ 200Hz
Signal to noise ratio	66dB minimum
Input overload capability	40dB minimum
Sink capability (mA max. continuous)	250mA
Phantom supply	nominally +20V via 1k0
VOX delay	3 seconds maximum

DIL switch settings for Microphone input modules M240/260/280

DIL switch	1	2	3	4	5	6
100uV - 1mV sensitivity	on					on
1mV - 10mV sensitivity		on		on		
10mV - 100mV sensitivity		on		on	on	
Phantom supply enable (all sensitivities)			on			

LINE INPUT MODULES	L240	L270	L300	L330	L340
Transformer input or unbalanced	T	T	T	U	U
Priority only or Priority/passive switchable	PP	PO	PO	PP	PP
Sensitivity 50mV - 100V	✔	✔	✔		
Sensitivity 75mV - 2.0V				✔	✔
Priority controlled sink	✔	✔	✔	✔	✔
Chimes		✔			✔
Chime Duration Sink		✔			
Audio activated priority (VOX)			✔		

GENERAL SPECIFICATIONS - LINE INPUT MODULES

Input mode	Transformer balanced, fully floating
Sensitivity range and impedance L240/270/300	50mV-650mV @ 10k; 600mV-8V @ 10k; 8V-100V @ 100k
Sensitivity range and impedance L330/340	50mV-775mV @ 4k7 nominally
Frequency response -3dB points ref. 1kHz	40Hz - 20kHz
Signal to noise ratio	70dB minimum
Input overload capability	26dB minimum
Sink capability (mA max. continuous)	250mA
VOX delay	3 seconds maximum

DIL switch	1	2	3	4	5	6
50mV - 650mV sensitivity @ 10k load	on				on	on
600mV - 8V sensitivity @ 10k load	on			on	on	on
8V - 100V sensitivity @ 100k load		***		on	on	
600 ohm line termination resistor enabled		on				

DIL switch settings for Line input modules L240/270/300

*** Note: To avoid damage, ensure that this switch position is off

GENERAL SPECIFICATIONS - TONE GENERATOR MODULES

Trigger switch requirements	1.5mA maximum @ +15V DC
Duration timer	2 - 30 seconds approx
Trigger memory capacity	Indefinite
Sink capability (max. continuous)	250mA
Generated frequency range (T270)	250Hz to 1200Hz, but depends on character
Rate of character	Depends on character

TONE GENERATORS	T260	T270	T300	T320
Momentary or timed triggering	M/T	M/T	M	M/T
Adjustable tone frequency	✔	✔	✔	✔
Priority hold forfull tone sequence	✔	✔		✔
Priority memory	✔	✔		✔
Adjustable duration timer	✔	✔		✔
Adjustable rate of character	✔	✔		✔
Character selectable by DILswitch		✔		

DIL switch settings forTone generator modules T270

DIL switch	1	2	3	4	5	6	7	8
Dee-dah, variable rate		on	on		on			on
Dee-dah, slow, fixed rate		on	on		on			
Dashes, variable rate			on	on				on
Dashes, slow, fixed rate			on	on				
Slow whoop (bomb alert)	on			on				
Warble, variable rate	on	on	on		on			on
Warble, slow, fixed rate	on	on	on		on			
Time pips, variable rate			on	on	on	on		on
Pips, slow, fixed rate			on	on	on	on		
Continuous tone only		on	on					on

MISCELLANEOUS MODULES	E260	
Function	Magnetic phono pre-amp	Ceramic phono pre-amp
Sensitivity	5mV@50k	80mV-1V @ 1M
Equalisation	RIAA	Flat

Input connections

Standard amplifiers are fitted with Locking 5 pin DIN input connectors on a 180 degree spacing pattern. See Fig. 2 below to identify the pin numbers. The input connections will vary depending upon which module is being used in the corresponding module position, as follows:

Balanced microphone & line input modules i.e. M240 to M280 and L240 to L300 inc.
NOTE: Microphone or line input modules cannot normally be used in non-priority or passive mode in mACRO zone control equipment. See the system design note on page 8.

Standard Locking 5 pin DIN -

Pin 1 ┐
} Balanced input
Pin 3 ┘
Pin 2 Signal earth (cable audio shield)

Pin 4 ┐
} Priority control (except audio activated modules)
Pin 5 ┘

Auxiliary inputs and music modules i.e. L330, L340, E260,
NOTE: These modules cannot be used for pre-amplification of music in ZG units. See the system design note on page 8.
Standard Locking 5 pin DIN -

Pin 1 Signal input
Pin 2 Signal earth (cable audio shield)
Pin 3 Signal input
Pin 4 ┐
} Priority control (except E260)
Pin 5 ┘

Fig. 2 DIN input connector pin identification - ZG units

Tone generator modules i.e. T260 to T320 inclusive

Standard Locking 5 pin DIN -

Pin 1	No connection
Pin 2	No connection
Pin 3	No connection
Pin 4	Priority control & tone trigger
Pin 5	

Locking 5 pin DIN connector plugs are not furnished automatically with the unit, and must be ordered as a separate item.

Module adjustments
Various adjustments are available on each module, dependent on type and function, etc and are shown in table 2. The general locations are shown in APPENDIX E.

FACILITY	USAGE or FUNCTION
Audio sensitivity	Sets the level of amplification of incoming signal. Influenced by no other adjustment
Chime level	Determines the level of chime tone to be injected. Influenced by no other adjustment
VOX sensitivity	Sets level of audio input at which the VOX circuit is triggered. Influenced by 'Audio gain'. Temporarily set sensitivity to maximum, and set Vox delay to maximum to enable 'Audio level' to be set using typical input signal, then reset 'VOX sensitivity' and then 'VOX delay'.
VOX delay	Determines the time delay between cessation of audio input signal and release of priority and/or muting of channel. Influenced by Audio gain and VOX sensitivity. Adjust those first.
Chime pitch	Sets collective pitch of chime sequence. Tones may not be adjusted individually. Influenced by no other adjustments.
Bass cut jumper	Move this jumper link to introduce a sensitivity roll-off at bass frequencies. Particularly effective for paging applications.
Priority/Access jumpers	Control the priority or Passive modes. See relevant information on page 12
Any sink jumper	Determines whether priority operation influences the ANY SINK output
Timer (duration)	Sets period of on-board timer within the range 2-30 seconds, after which the priority is released and tone ceases. Influenced by no other adjustments.
Rate	Sets the character frequency of Dee-Dah, warble, dash, etc, tone generation. Influenced by no other adjustment.
Mom/Timed	Determines whether the tone is generated only for the duration of the trigger, or via the timer.
Output level	Sets level of audio or tone tone output from module. Influenced by no other adjustment.
Pitch	Sets audio pitch of tone generation sequence. Influenced by no other adjustments.
ALC threshold level	See Factory Fitted Options - Automatic level control, on page 21. Influenced by no other adjustmen on this module.
ALC sensitivity	See Factory Fitted Options - Automatic level control, on page 21. Influenced by no other adjustment on this module.
Surveillance tone level	See Factory Fitted Options - Line surveillance on page 22. Influenced by no other adjustment on this module.

Table 2 Module adjustments and settings

PRIORITY INPUT FACILITIES - ZG units only

Each MACRO Zone Group Controller can be programmed to provide up to 8 levels of signal priority which may be arranged in a descending order access (sometimes referred to as 'ladder priority', or an equal access priority, or any combination of both. The modules available may be categorised into 'priority' and 'passive' modules, and it is the 'priority' modules which generate the ladder sequence. Thus if a controller were fitted with say five priority modules, then obviously only a maximum of five levels of priority could be available. However, the controller containing the five modules may be set up to exhibit ladder priority, for example, on inputs 1 and 2 whilst inputs 3-4-5 may be given equal access. This set-up could now be referred to as exhibiting just 3 levels of priority.
Equal access is a form of priority whereby the first to access the priority chain locks out one (or more) other inputs for the duration.
As supplied from the factory, the controller will exhibit a ladder sequence downwards from input No.1 as first priority. Equal access between any modules must be between physically adjacent modules, and is instigated by depressing the small blue PCB switch button which is located between the module input sockets on the main mother PCB. See Fig. 3. There are 7 such switches, and any number may be depressed at any time to give the required priority arrangement.
In all cases, the priority functions of priority modules are triggered by bridging pins 4 and 5 of the DIN channel input socket. The switching

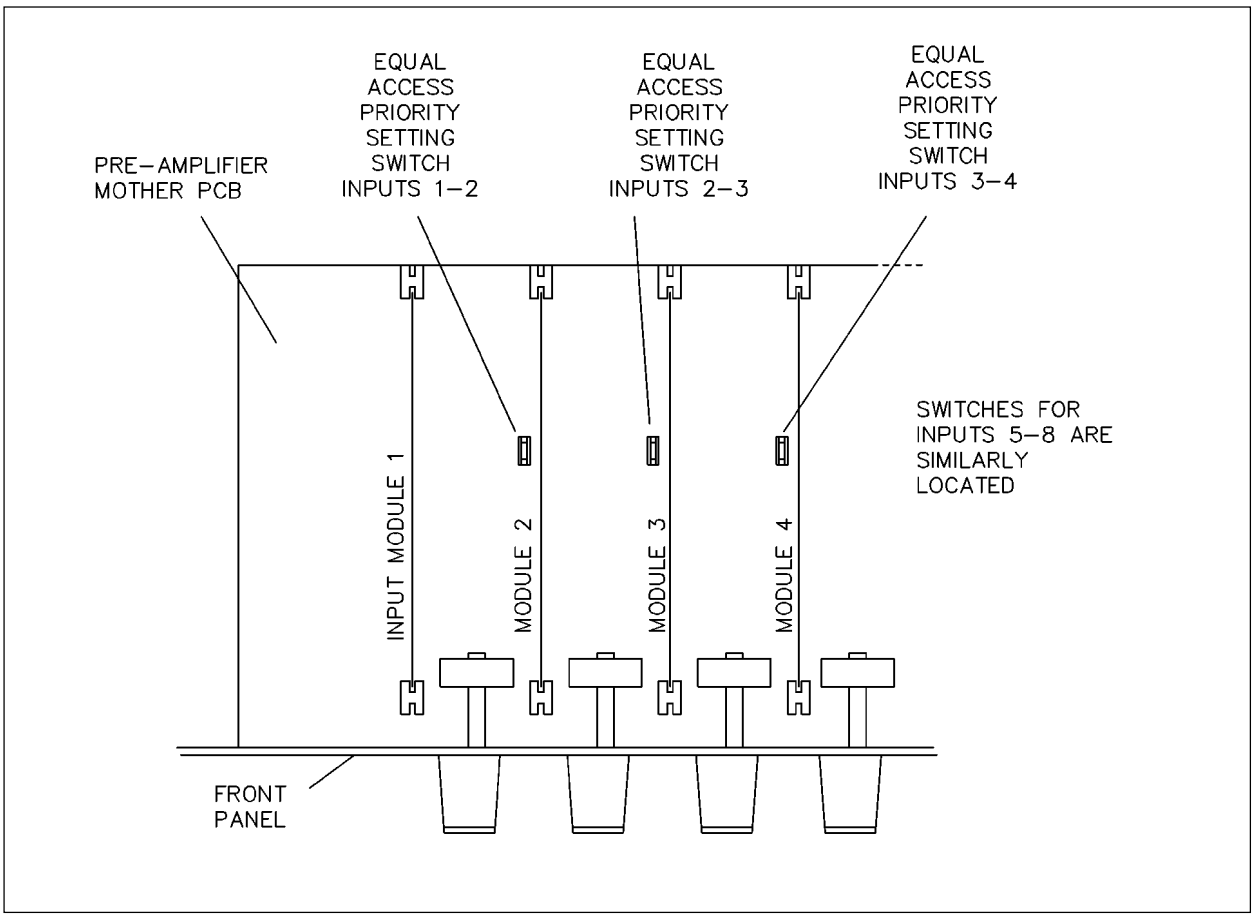


Fig. 3 Location of priority sequence setting switches - ZG units

current is in the order of 2mA @ 15V. On successful access to the signal priority chain, the module circuitry will perform certain functions:

a) Modules of equal or lower priority will be inhibited, whether of priority or passive format.
b) The audio signal path of the accessed module will be enabled
c) The module current sink (250mA max) will be enabled
d) The 'any channel' current sink will be enabled (250mA max)
e) The modules in immediately higher priority will be inhibited if the equal access PCB switches have been set
f) The tone sequence of a tone generator module will be started either via the module timer circuit, or momentarily for the duration of the trigger
g) The chime sequence of a chime-microphone module will be triggered and consequently enable a CDM (chime duration monitor) current sink to be energised (250mA max).

Should a module which is currently in an accessed mode be inhibited by the triggering of a higher priority module, all the above functions - a) to g) where appropriate - will be lost immediately, for the duration. However the timer function will still be operative and may re-enable the original module, if timing permits, when the higher priority is released.
Audio activated (VOX) modules attempt to gain access by triggering on amplitude peaks and the resulting functions are consistent with a) to e) above.

Priority/passive setting of modules
Certain modules contain features enabling the commissioning engineer to set them to operate as normal priority modules, or as passive modules. All modules used in ZG zone group controllers must be set to operate in priority mode. Modules are normally supplied in this mode by the factory. To ensure that this is still the case, referring to APPENDIX E, this is accomplished on the M240 microphone input module, for example, by transposing the position of a jumper link on the module, from lower left (position A) to lower middle (position B) for the change to priority mode. In this mode, the module audio signal path is disabled, though it will be enabled by bridging pins 4-5 of the standard DIN input socket.
The jumper link is a simple push fit.

Priority memory
If, whilst a priority module is being accessed, an attempt is made to trigger a tone generator module which is installed in a lower priority level, and which features a priority memory, then no apparent action will result until the higher priority is released, at which time the memory circuit will automatically and immediately trigger the timer circuit of the module, causing it to operate in the normal manner for its pre-set duration.

PRE-ANNOUNCEMENT CHIMES - ZG units only

The customary ding-dong chime signals which can often be heard to precede announcements in public buildings, are generated in MACRO range equipment by certain standard microphone or line input, and tone generator modules. It is possible therefore to install two or more such modules, and adjust them so as to be readily distinguishable. The chime is triggered only on successful access to the priority chain. See APPENDIX E for location of adjustments.

MIXER FACILITY CONNECTIONS - 0dB SIGNAL ACCESS POINT

ZG/4 and ZG/8 This connection may be used to gain access to the signal chain at a point where the priority audio is linked from the internal pre-amplifier section to the output buffer section, and is at 0dB level. This co-incides with the master gain control position, and access is available pre- and post- this control. Connection is by Locking 5 pin DIN panel socket with 180 degree pin spacing pattern.

The standard pin connections are as follows:-

Pin 1 Pre master gain control. 775mV, 600 ohms source, direct from the TB.6 module
Pin 2 Signal earth (cable audio shield)
Pin 3 Post master gain control, 10k source

With the master control at position "0" the loading effect exhibited by pin 3 is approximately 6k8 ohms. For further clarification of this arrangement see the block schematic diagram - APPENDIX A

ZC.8 The mixer facility connection is the priority audio input connection to the output buffer section., and is at 0dB level. Connection is by Locking 5 pin DIN panel socket with 180 degree pin spacing pattern.

The standard pin connections are as follows:-

Pin 1 No connection
Pin 2 Signal earth (cable audio shield)
Pin 3 Audio input. 775mV @ nominal 10k load

Signal arrangements and DIN cable connections are shown in Fig. 4

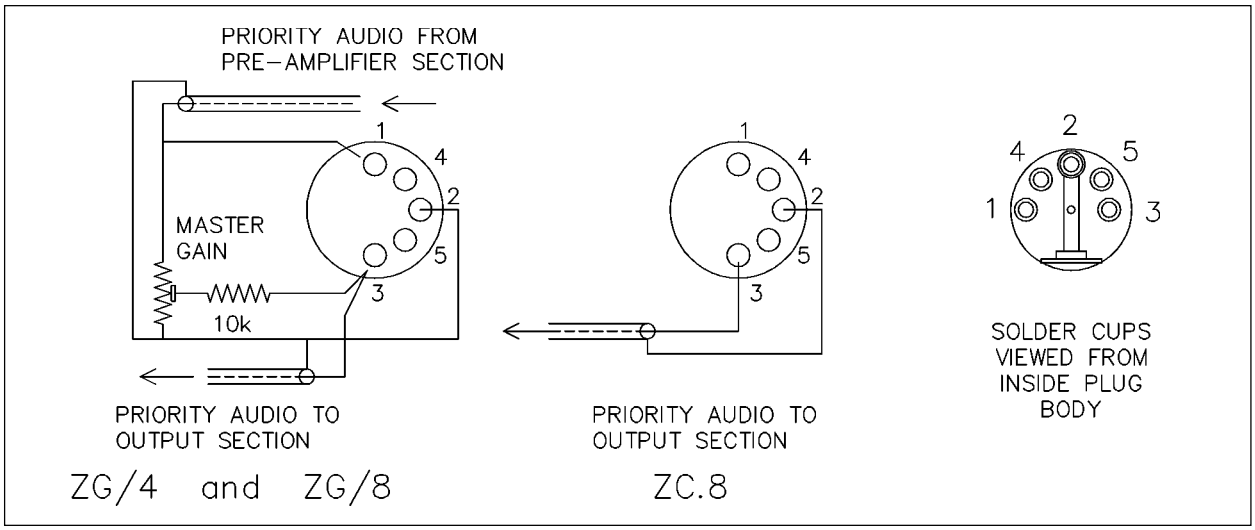


Fig. 4 Mixer facility socket connections

Tape recording and playback
The Mixer Facility socket of a ZG/4 or ZG/8 will provide suitable signals for tape recording, though it will normally be necessary to make up a suitable recording and/or playback lead. This socket is associated with the master gain control, so either pin 1 or pin 3 of the standard Locking DIN connector may be taken as the signal connection dependent on whether the recorded signal is to be influenced by it:-

Pin 1 signal output, non-dependent on master gain control
Pin 2 signal earth (cable braiding)
Pin 3 signal output via master control
Pin 4 no connection
Pin 5 no connection

For recording on a stereo recorder connect both left and right channel signal input connections together to pins 1 or 3 as required.

The manufacturer's handbook should be consulted to ensure that the recorder will accept signal levels of approximately 0.75V without distortion and that the recorder does not short out the signal recording connections when in the playback mode. In either case, insert a resistor of suitably high value in series with the recording lead. An experimental starting value would be 22k ohms. See Fig. 5.
Certain tape decks send a signal from the tape playback output during a recording session. If, in this case, the recording and playback leads are connected simultaneously to an input channel of the amplifier, a closed-loop feedback path to the amplifier will result and cause problems unless the loop is broken. This in its simplest form would necessitate disconnecting the tape playback lead whilst recording, or

alternatively, reducing to zero the amplifier input gain control associated with playback.
Playback may be achieved through either ZG or ZC units via the Auxiliary Audio input connector. The front panel Auxiliary Input selector switches will need to be operated for directing the signals to the appropriate output zones.

5 pin locking DIN 180 degree chassis socket connections:

Pin 1 no connection
Pin 2 signal earth (cable braiding)
Pin 3 audio signal input
Pin 4 no connection
Pin 5 no connection

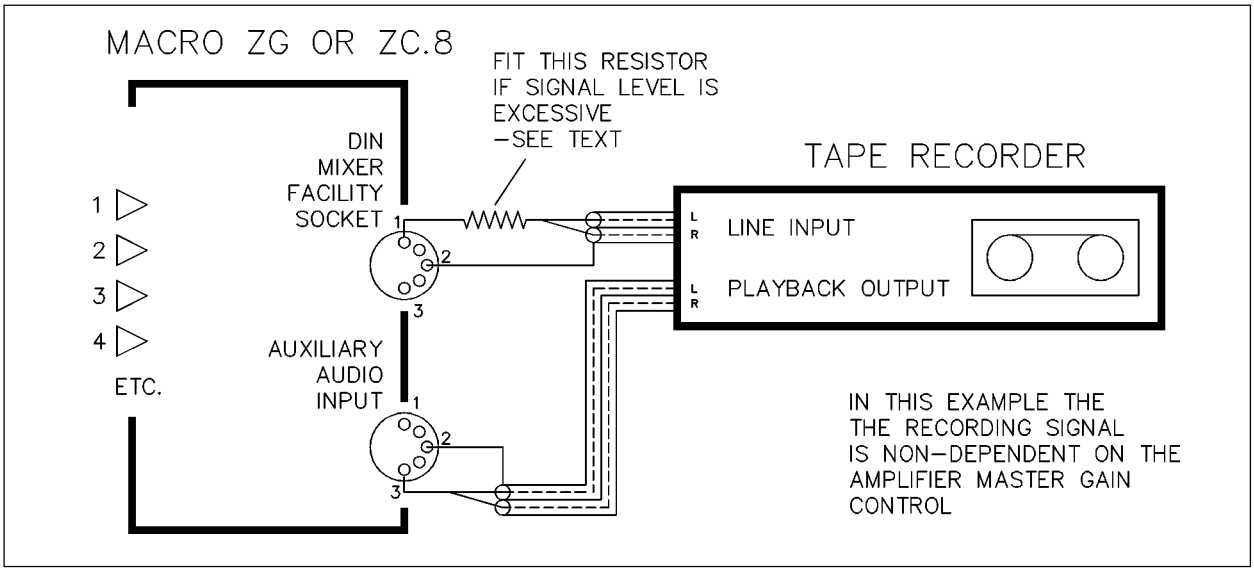


Fig. 5 Tape recording and playback connections

Interconnection of several controllers
Larger scale amplification systems may necessitate the interconnection of several zone control units and amplifiers. ZG and ZC units may be mixed easily as required to provide the required numbers of input and output circuits. The general technique is illustrated in Fig. 6. Two ZG/8 units are shown interconnected, though ZG/4 and ZG/8 units can be treated in the same way. ZC.8 units may be used with a ZG unit to increase the number of output zones available. Disregard references to input modules, and the priority audio link, etc.
The interconnecting audio cables should be single conductor screened, and the braid/shield connections should also be made between the appropriate DIN connector pins.
NOTE: - that when planning a system with interconnection of two ZG units, for example, the first input channel of the second unit will be taken up by the priority audio signal interconnection. For example, a ZG/8 and a ZG/4 used together will provide a maximum of 15 priority inputs, rather than 16, and the full 12 buffered outputs. The front gain control of this input channel would normally be set to maximum, assuming that a line level input module is fitted.
Note also that the master gain of the first ZG unit will need to be adjusted to zero to prevent audio from inputs 1 to 8 inclusive reaching the output section directly. The master gain control of the second unit will become the system master.
Equal access priority will be available only between inputs 1 - 8 and between inputs 9 -15. Input 8 can exhibit only ladder priority over input 9.

AUXILIARY OUTPUT CONNECTION - ZG units

A standard 25 way 'D' connector on the amplifier rear provides all the auxiliary connections associated with current sinking, alarms, auxiliary DC outputs, etc., The connections are as follows:

1 250mA current sink activated by input module No.1 during priority access
2 250mA current sink activated by input module No.2 during priority access
3 250mA current sink activated by input module No.3 during priority access
4 250mA current sink activated by input module No.4 during priority access
5 250mA current sink activated by input module No.5 during priority access
6 250mA current sink activated by input module No.6 during priority access
7 250mA current sink activated by input module No.7 during priority access
8 250mA current sink activated by input module No.8 during priority access
9 250mA current sink bus activated by any module gaining priority access
10 250mA CDM current sink bus activated by any module with this feature
11 0Vforgeneral purpose
12 24V+ DC unregulated, for use with current sinks
13, 14 Mains power input failure alarm contacts - normally open
15, 16 DC power input failure alarm contacts - normally open

...continued on page 15

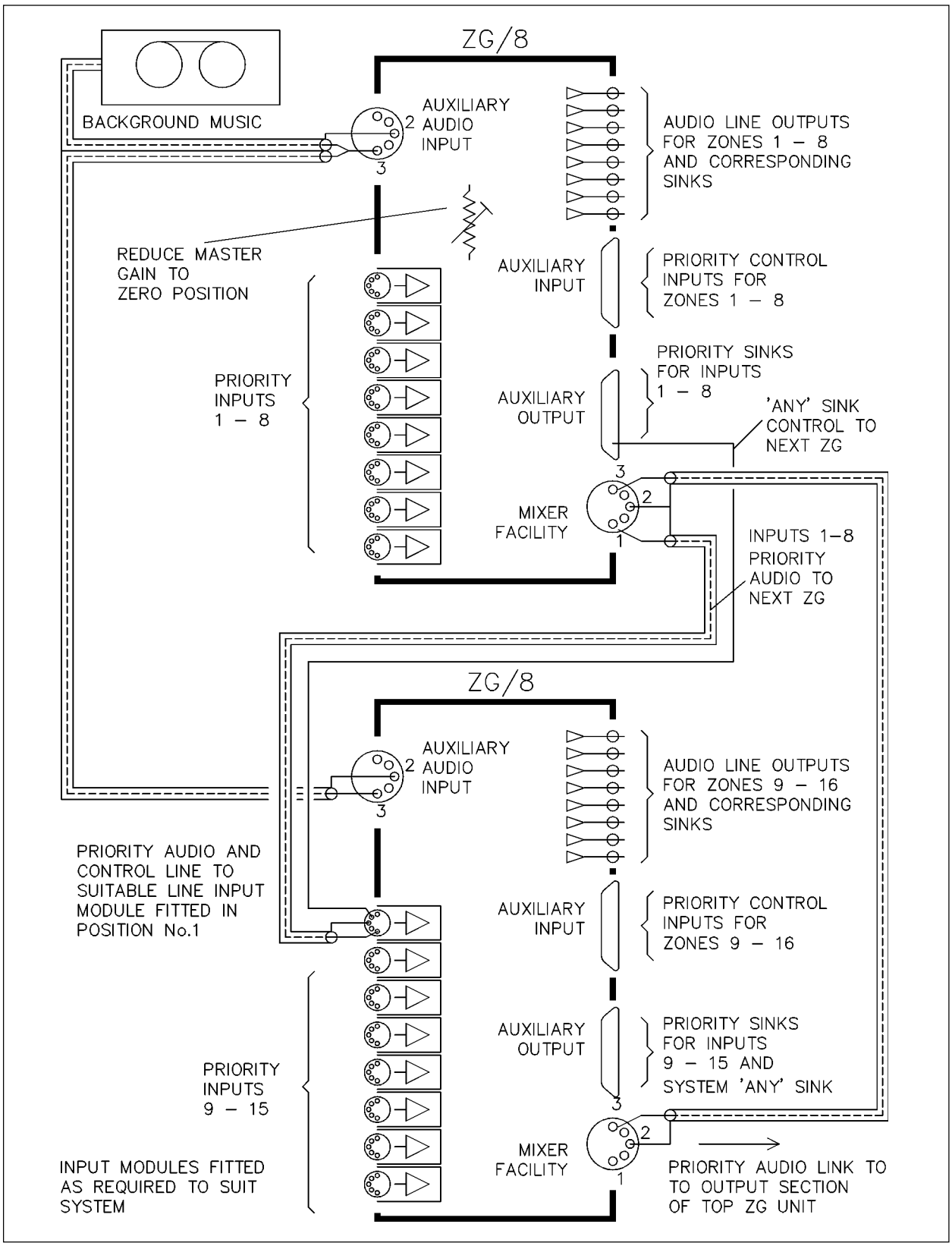


Fig. 6 Interconnection of two or more ZG units

17	}	for future use.
18		
19		
20	nc	
21	nc	
22	nc	
23	nc	
24	nc	
25	nc	

Notes:

a) The current sink connections originate on individual modules. These current sinks are unfused and can carry a maximum of 250mA from a positive (+ve) source. Each module features a surge limiting resistor.

b) The pin 12 connection originates from the PMB.12 module where a F1A fuse is located - see APPENDIX D

c) The 'fail' alarm connections are 'open' when the unit is de-energised, and closed during normal powered operation.

Notes:

a) The current sink connections originate on individual modules. These current sinks are unfused and can carry a maximum of 250mA from a positive (+ve) source.
b) The pin 12 connection originates from the Power Management Board where a F1A fuse is located - see APPENDIX D
c) The 'fail' alarm connections are 'open' when the unit is de-energised).

Priority controlled DC current sinks

This unusually comprehensive feature is useful in microphone paging or alarm systems where a number of operations may be required co-incident with the use of the input priority facilities, or where a number of operators have access to the system and need to know when the system is in use. Typical uses could be:-

a) The powering of lamps at a microphone position, to indicate that the amplifier priority system is already in use (by an automated alarm tone generator, or another operator, for example)
b) The interruption by means of a relay of the sound output of another amplification system.
c) The sending of a low-level priority paging signal by means of a relay, to another remote amplification system.
d) Control of further zone control unit from the Mustang ZC or MC ranges.
e) To re-assure a microphone operator, by means of a lamp indicator, that they have gained priority access to the system.

Note: The operation of loudspeaker volume restoration circuits would normally be controlled by the current sinks of the individual Line Output connector. See APPENDIX C.

The principle of operation is that when the signal priority circuit of any of the input modules is activated, the associated DC current sink is operated and the associated terminal of the Auxiliary output connector - becomes a 0 Volt point. This is used to complete a simple external circuit comprising relays or lamps etc., connected to the +24V DC terminal.
Terminals 1-8 are individual sinks controlled individually, whilst terminal 9 is activated whenever ANY of the individual sinks is operated.
The current sinks are polarity protected for use in positive (+ve) applications up to 40V. DO NOT ATTEMPT to pass more than 250mA.
NEVER connect the +24V and current sink connections directly together - serious damage to the module will result. In the off state there is effectively no connection.
See APPENDIX C for typical applications of the Auxiliary Output connections.

Chime duration monitor sinks - (CDM)

This facility is provided on those modules which feature a chime generator. The sink output lasts for the duration of the chime tones (which are triggered on priority access) and the the individual sinks are connected to a sink 'bus'
so that a lamp may be energised on a paging microphone to indicate at which point to commence speaking. This connection is unfused, and is limited to 250mA from a positive (+ve) source. See APPENDIX C for typical application.

24V Aux DC supply

The 24V+ terminal (pin 12) of the Auxiliary output connector provides an unstabilised DC supply, which is limited to 1 amp by an internal fuse on the PMB.12 Power Management Board (see APPENDIX D) and the return is via the 0V terminal. This feature would normally be used with the DC current sinks. Note that this voltage surges to about +35V off load when the unit is AC powered.

AUXILIARY INPUT CONNECTIONS

A standard 25 way 'D' connector on the rear provides all the auxiliary connections associated with control of the line output modules. The standard connections are as follows:

1	Control group No. 1	
2	Control group No. 2	
3	Control group No. 3	
4	Control group No. 4	
5	Control group No. 5	(ZG/8 & ZC.8 only)
6	Control group No. 6	(ZG/8 & ZC.8 only)
7	Control group No. 7	(ZG/8 & ZC.8 only)
8	Control group No. 8	(ZG/8 & ZC.8 only)
9	ALL ZONES control	
10		
11	0V control return	
12	24V +DC unregulated output for use with current sinks	
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

Current Sinks

These are electronic circuits which behave as switches and may be used to operate external devices such as relays, LED's or other circuitry such as logic controls. All Mustang equipment utilise the sink such that when it is energised - for example when a priority circuit is accessed - then these "switch" contacts are closed and the external device is energised. Otherwise, the sink is effectively open-circuit and volt-free. There are no constraints other than a maximum current carrying capacity, a maximum voltage that may be used with the external device, and that it must always be a positive voltage. Circuitry surrounding the Mustang current sinks provides them with a degree of protection. See Fig.7 below.

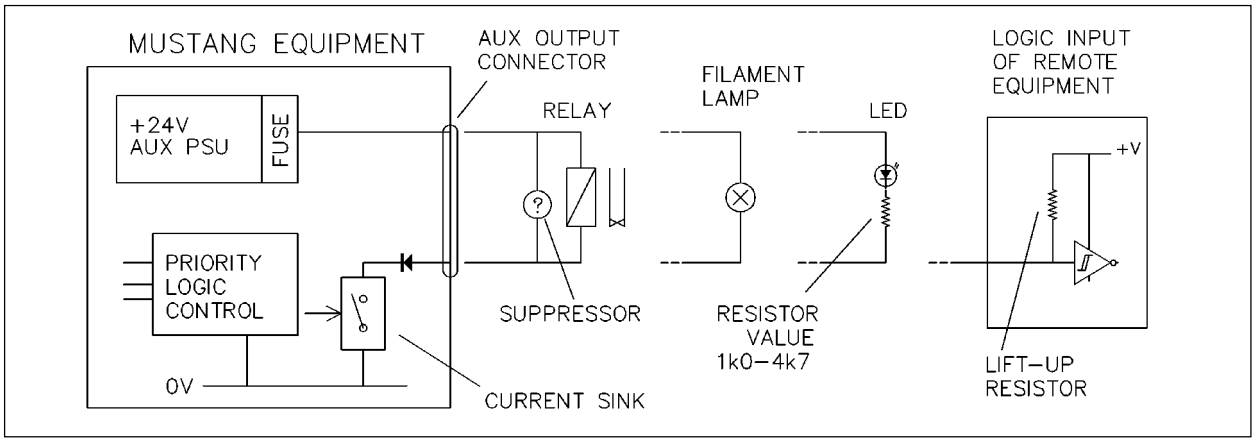


Fig. 7 Typical applications of current sink feature

LINE OUTPUTS & ASSOCIATED FACILITIES

The line output section of ZC.8 units features audio buffer amplification, current sinks and audio priorities related to the output zones, and auxiliary audio front panel selector switches. In normal circumstances all audio input to a ZC.8 is derived externally, either from ZG units or other priority audio system, connected to the Mixer Facility or Auxiliary Audio DIN input sockets, whilst the control inputs would be from alarm, microphone control, or similar switching systems, or from ZG units.

ZG units feature all of the above, in addition to zone group pre-selection switches. In normal circumstances the priority audio will be derived from the pre-amplification section of the unit, which is linked across internally, the Auxiliary Audio will be derived from an external music source for example, and the priority control of the output zones will be associated with the current sinks of the pre-amplification section. The latter may be interconnected via paging microphone zone keys, or fire alarm control panels.

Output modules and adjustments

Output modules are allocated zones 1 to 4 (1 to 8) numbered from left to right, when facing the inside rear of the unit. They are self contained audio buffer amplifiers and associated control systems associated with the Line Output connectors of the rear panel.

The module features include:- output zone priority control circuitry, gain controls for the priority and auxiliary audio inputs, a priority controlled current sink, and low impedance unbalanced output driver circuitry.

The gain controls enable different settings of the audio levels of both priority and auxiliary audio in any combination to any of the output zones.

The pre-sets nearest the rear of the chassis are for the Auxiliary Audio. Rotation clockwise increases gain. The variation is from unity to approximately -20dB. See Fig. 8 for identification of the controls.

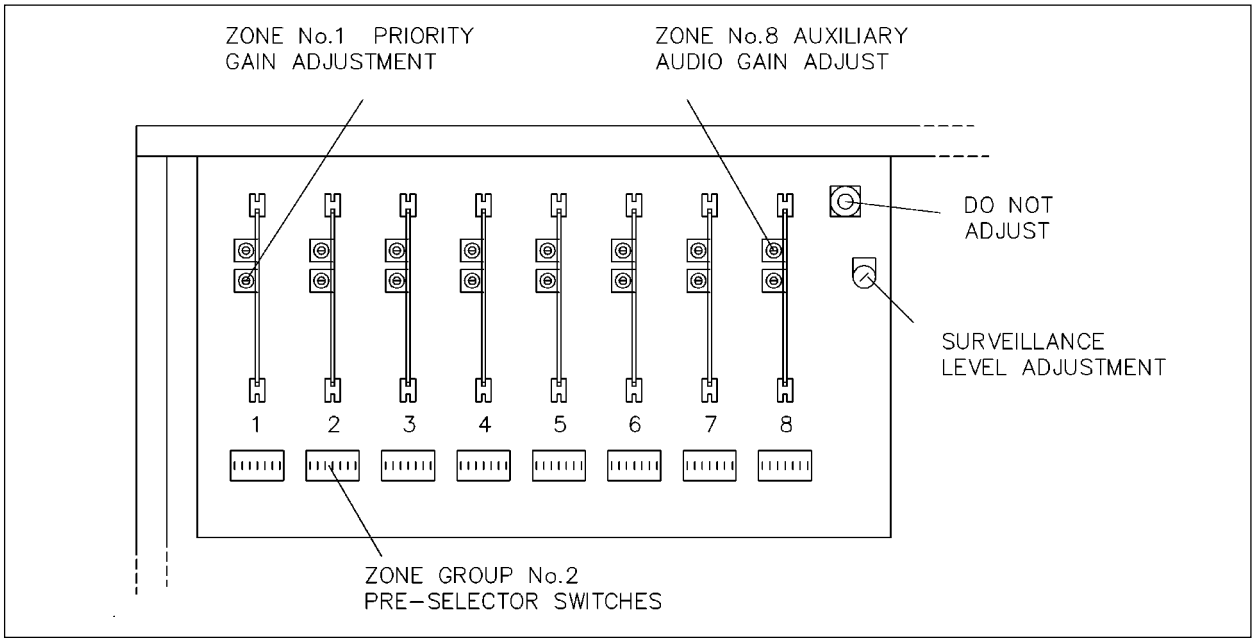


Fig. 8 Identification of output section components

Zone group control inputs

The Auxiliary Input connector features a series of control connections, each of which corresponds to a DIL group pre-selector switch located on the output mother PCB. Each of the switch poles of the DIL switch corresponds to one of the output buffer modules feeding the Line Output sockets of the rear panel. If one of the above control inputs is connected to 0V, the associated DIL switch triggers the group of output modules that have been pre-selected by the DIL switch, enabling priority audio whilst muting the auxiliary audio to those modules. Priority audio, and a current sink appear at the corresponding line output sockets. The operation of the remaining output modules remains totally uneffected. See Fig. 9

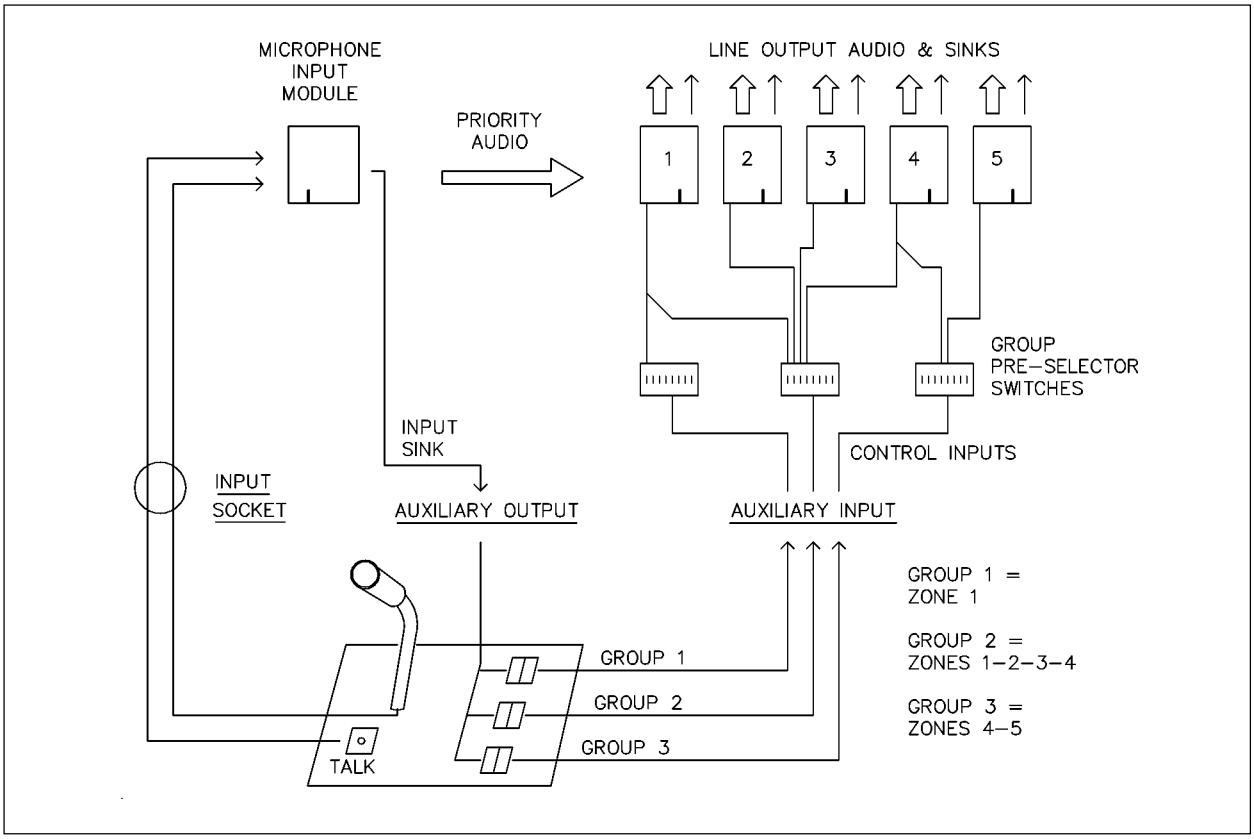


Fig. 9 General control concepts for ZG units

Line output zone current sinks

Simultaneously with one of the line output buffer modules being energised via the an Auxiliary Input control connection, a current sink appears at the corresponding Line Output socket. This sink, being associated with one specific output zone would typically be used for the following:-

a) Operation of volume restoration relays in the associated loudspeaker zone(s)
b) Sending information to a microphone operators control panel confirming that the required zones have been successfully accessed.
c) Operation of subsequent controller functions for loudspeaker sub-zones
d) The interruption by means of a relay of the sound output of another amplification system located in that specific zone.

The principle of operation is that when the signal priority circuit of any of the output modules is activated, the associated DC current sink is operated and the associated terminal of the Line Output connector becomes a 0 Volt point. This is used to complete a simple external circuit comprising relays or lamps etc., connected to a positive DC source of up to 40V. See Fig.7 for examples.

The current sinks are polarity protected for use in positive (+ve) applications only. DO NOT ATTEMPT to pass more than 250mA. NEVER connect the positive DC source and current sink connections directly together - serious damage to the module will result. In the off state there is effectively no connection.
Current sink outputs operate via the DIN line output connectors. See APPENDIX C and Fig.7 for typical applications.

24V Aux DC supply

The 24V+ terminal (pin 12) of the Auxiliary input connector provides an unstabilised DC supply, which is limited to 1 amp by an internal fuse on the PMB.12 Power Management Board (see APPENDIX D) and the return is via the 0V terminal. This feature would normally be used with the DC current sinks. Note that this voltage surges to about +35V off load when the unit is AC powered.

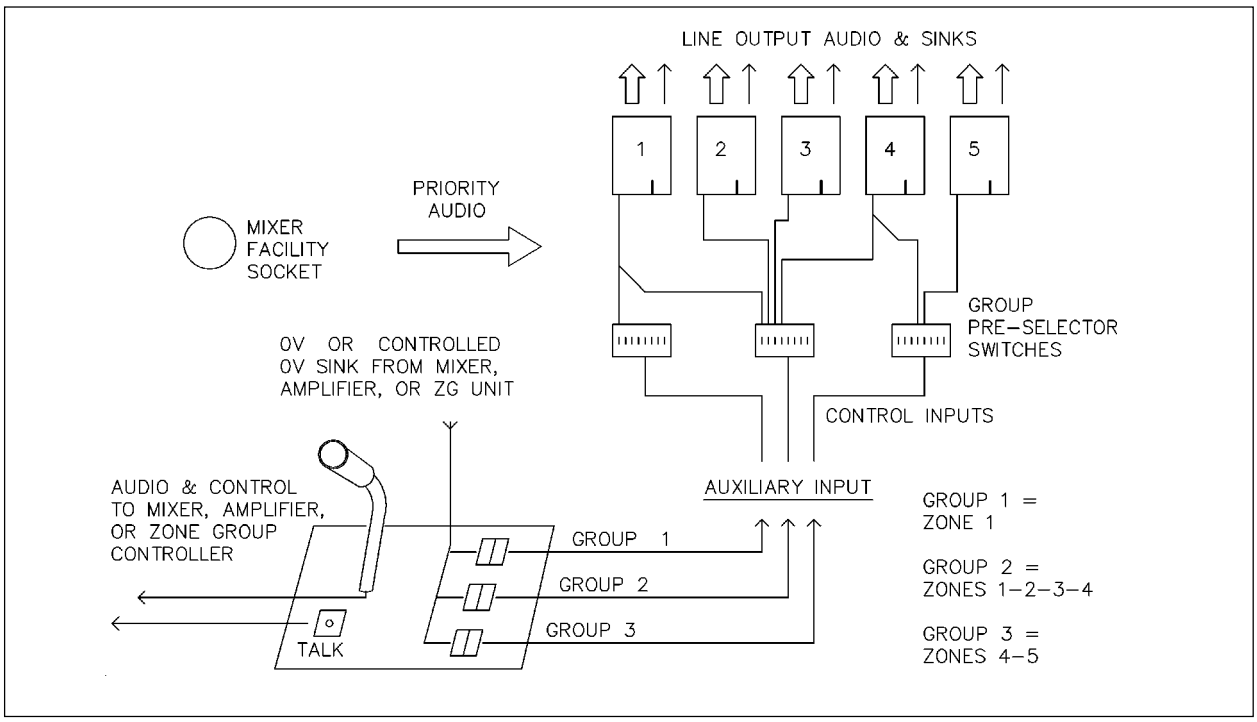


Fig. 10 General control concepts for ZC.8 units

Zone group pre-selector switches

The switch banks located in front of the ouput modules on the mother board are for output group selection. 4 are fitted to the ZG/4 and 8 for the ZG/8 and ZC.8. The commissioning engineer will need to set these switches to the requirements of the system.

Output modules are allocated zones 1 to 4 (1 to 8) numbered from left to right, when facing the inside rear of the unit, and the switch bank poles use the same numbers. When a pole is 'closed', or 'ON', the associated output module trigger is primed ready to respond to the corresponding group control input of the Auxiliary Input connector. If required, each switch bank could be set up for just one module each, resulting in a simple zone control unit where each of the Auxiliary Input control connections would correspond to one zone.

Units leave the factory with switches set such that control No.1 will trigger Line output No.1, and control No.2 will trigger output No.2 etc. Poles 5 to 8 of switches fitted to ZG/4 units are unused. See Fig. 8 or APPENDIX D for identification of the pre-selection switches, and Fig. 9 for clarification of the control concepts.

Line output socket connections

Locking DIN 180 degree chassis socket:

Standard unbalanced line output version

Pin 1 Signal
Pin 2 Screen
Pin 3 n/c
Pin 4 Priority 0V (fixed)
Pin 5 Priority control sink output

For details of how the standard unbalanced line output my be interconnected to a suitable power amplifier, see Fig. 12 on page 22.
A standard factory fitted option offers balanced/floating line output audio. See page 22 for details.

AUXILIARY AUDIO INPUT

Input signals from external audio devices may be connected to the Auxiliary Audio connector at the rear. This socket would for example be used for music signals. The signal is taken to the output modules via front panel selector switches. Background music would be available in those zones selected, but it would be disabled in any of those zones during any subsequent periods of priority access. See APPENDIX C

5 pin locking DIN 180 degree chassis socket connections:

Pin 1 no connection
Pin 2 signal earth (cable braiding)
Pin 3 audio signal input
Pin 4 no connection
Pin 5 no connection

POWER SUPPLY

AC Mains power input

A standard IEC 3 core cableset is supplied with each **MACRO** unit. It is essential that the safety Earth connection is made properly, as the chassis of the unitis earthed via this facility. The mains power required is 220V to 240V AC at 50-60Hz.

Where the unit is to be powered from a two-wire AC supply, the rear screw earth terminal must be permanently connected to a suitable safety earth point. This terminal is indicated by the symbol -

DO NOT operate the amplifier under any circumstances without an electrical earth connected.

DC power input

All ZG.4, ZG.8 and ZC.8 are designed to operate from 24V DC during periods of mains supply failure. It is permissible for this voltage to vary between 20V and 28V without undue problem. A MIL97 military style connector is supplied with each unit, and the corresponding connections are printed alongside the panel connector, as follows:-

Pin A	+24V	(battery positive)
Pin B	(Chassis)	
Pin C	0V	(battery negative)

Important: If either positive or negative terminals must unavoidably be earthed outside the unit then it must be the NEGATIVE. Note that the DC connections are not free of earth, as the signal earth and DC (-) of the amplification are unavoidably connected to chassis by a wire link as part of the signal earth system.
Any conflict of DC earthing with a battery connected will almost certainly result in severe and immediate damage to various fixed PCB tracks, and to the module printed circuit tracks if incoming circuitry is earthed too.

Systems powered by both AC and DC supplies

Systems utilising several MACRO units to be powered from both AC and emergency DC supplies should be connected such that the AC is supplied by the routine mains supply - for normal operation, and upon failure of this, the DC is supplied from an emergency DC battery system with integral charging circuitry. For clarification see Fig. 11

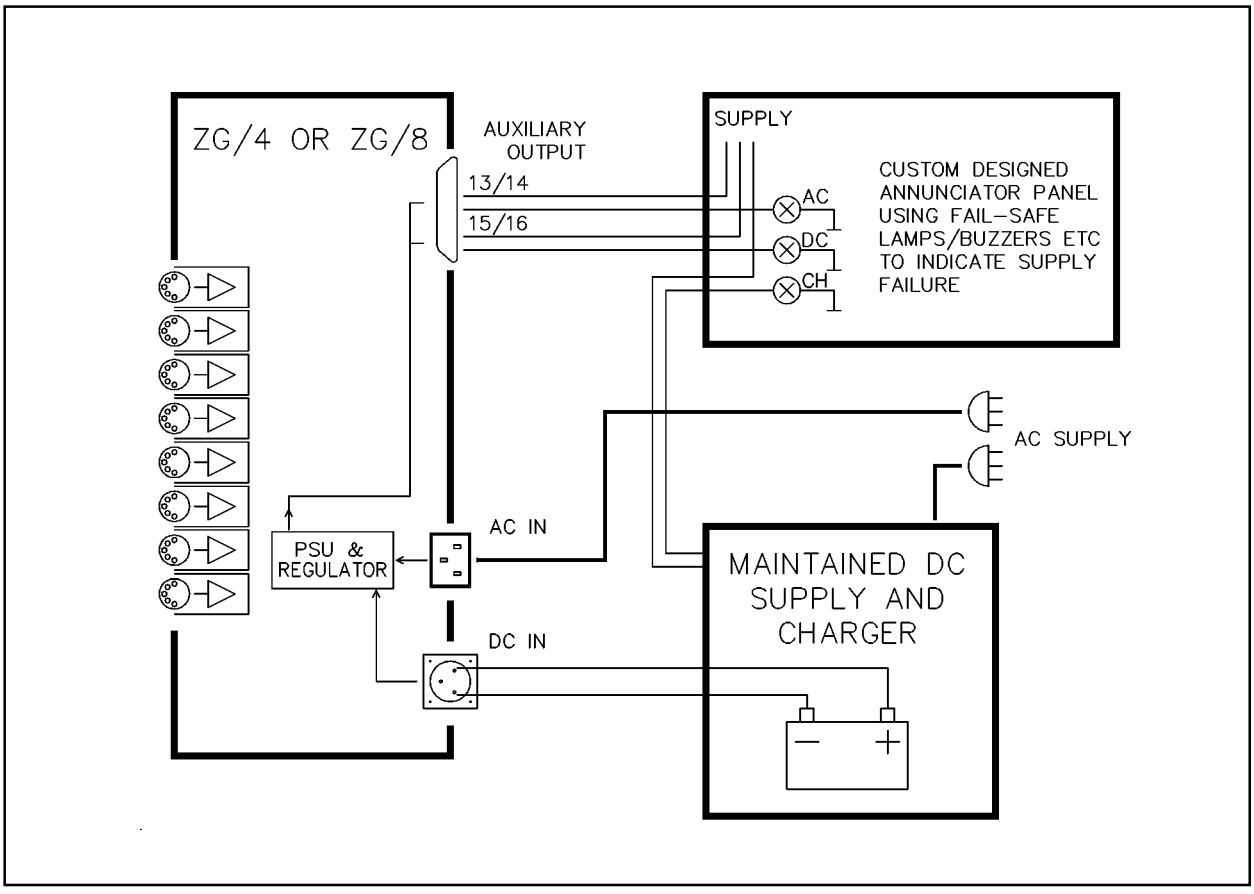


Fig. 11 AC & DC supply connections and monitoring

Main ON-OFF front panel switch
AC and DC switching is accomplished on the Power Management PCB, controlled by the front panel Power switch. AC Mains-only powered units are switched in both the Neutral and Live connections. AC/DC units are switched in both the Neutral and Live connections and in the +ve DC input connection simultaneously.

'POWER' indicator LED
This LED confirms that a suitable AC or DC supply is powering the amplifier and that the internal PSU circuitry is functioning correctly.

'SUPPLY STATUS' indicator LED
A three colour LED is used to indicate the integrity of AC and DC power supplies:

Green	AC supply connected
Red	DC supply connected
Orange	AC and DC supplies connected

Power supply failure monitoring
The 'Auxiliary' output D connector provides the facility to monitor the integrity of both the AC mains and DC standby supplies. Each supply energises a relay with light duty normally open contacts which are taken to pins 13/14 and 15/16. The relays are located on the Power Management Board and will drop out as a result of :-

AC: AC supply failure
AC fuse failure
AC supply disconnection
Unit switched off
Rectifier circuit failure

DC: DC supply fuse failure
DC supply disconnection
DC standby supply failure
Unit switched off

These relay contacts may be used to trigger remote audible or visual alarms within the system to draw attention to a possible problem.

Power supply change-over
This function is carried out automatically and instantaneously upon failure of the regular AC mains supply. There is no break in service and all facilities are retained for the duration of the condition. Upon reinstatement of the AC supply, the unit automatically reverts to AC operation.
The change-over process may be monitored by making use of the power supply failure monitoring relay contact mentioned above.
See Fig. 11 above, for clarification.

EARTHING AND HUM LOOPS

In all systems it is possible to inadvertently set up a hum loop. Each manufacturer has different methods of earthing his equipment and so lack of familiarity with them may result in problems. A loop will manifest itself as a low level soft hum at either 100Hz or 50Hz which is not generally effected in tonal or amplitude content by any user or adjustment controls. There are many potential earth loop paths in any system, but the larger the system, the more they are compounded, and resolving the problem can be extremely exasperating unless a disciplined and logical approach is used.
Each system must be considered separately although rules of thumb do apply. Generally an audio loop will be set up wherever two points in an audio system are interconnected by two earth paths. The resulting circuit will act as a 'turn' in a transformer, with any stray magnetic fields setting up resultant electrical currents in it. These currents are superimposed on whatever currents are intentionally there, and these may be very low level audio signal currents.
The electronic circuitry within the chassis is earthed to chassis via a green wire link adjacent to the mixer facility socket. Under certain circumstances it may be disconnected to simplify the signal earthing arrangements.
(See also the preceding sections covering the 'Mains power input' and 'DC power input' requirements).
In designing the MACRO system, we have borne in mind that the applications for the equipment will generally be in large scale installations where there may be many conflicting requirements. Therefore MACRO amplifier chassis are always earthed via the power input connections or the rear panel safety Earth stud, identified by the symbol:-

********** **THIS IS A SAFETY EARTH AND MUST NEVER BE DISREGARDED.** **********

Particular care should be taken when terminating the Locking DIN input plugs, as the cable clamp will connect with the plug body on assembly and thence with the units' rear panel on insertion. Thus, if the signal cables' audio screen is connected both to the clamp and to pin 2, a loop will result. Similarly with the mixer facility connector. Aim to earth each unit fully in one place only, with interconnection of amplifiers or ancillary equipment via input modules featuring transformer input circuitry, - for example L.240 to L.300. These may be wired in a fully floating mode thus providing full isolation. Connect the audio screen of a signal cable to a signal earth at one end only.
Bear in mind, also that with DC powered systems, the signal earth of each amplifier will be connected to the -ve terminal of the DC supply. If that is already unavoidably earthed, it dictates that it must be the central earthing point of the system.

LINE SURVEILLANCE

Line surveillance in the MACRO zone group controller system is carried out by injection of an encoded supersonic tone into the audio signal path at the line output module. This tone is mixed with the routine audio signals and passed to subsequent amplification for delivering power to the loudspeaker network. The ratio of relative amplitudes of these two type of signals, when mixed will effectively remain constant.
The presence of the current which the surveillance signal induces into the loudspeaker line is subsequently monitored for deviation from a pre-set level. The amplitude of the injected signal is factory set and should not need further adjustment. Should it subsequently be necessary, the control potentiometer may be found at the top-left corner of the output mother PCB. Turning the control clockwise will increase the level of injection. The correct setting is such that 2V is the amplitude of the signal appearing across the fully loaded loudspeaker output terminals at the corresponding amplifier. Useful re-adjustment of this control can be accomplished only with the aid of an oscilloscope of suitable bandwidth. Alteration of tone control settings of the controller will not effect the surveillance injection. Do not attempt to alter the ferrite cored inductor of the injection circuit.
The loudspeaker current monitoring function as mentioned above would be facilitated by using a MACRO SL/10 unit.

FACTORY FITTED OPTIONS

ZU/BAL Transformer balanced line output fitted to individual output modules
TB/ALC Automatic audio level control (ALC) - available on ZG units only

Transformer balanced line output
Mustang product code - ZU/BAL

This option may have been specified where long signal lines will be connected to the line output, or where a system engineer wishes to minimise any possibility of Earth/hum loops in a complex system, for example. The transformers are mounted on the output buffer modules. Line output connections are as follows:

Pin 1	┐	floating line 0dB
	}	balanced output signal
Pin 2	┘	
Pin 3	n/c	
Pin 4	Priority 0V (fixed)	
Pin 5	Priority control sink output	

It is possible to use either single or twin screened cable to connect to the power amplifier, depending upon whether the amplifier has unbalanced or balanced input connections. See Fig. 12 for clarification and examples. For balanced output to balanced input operation, the braiding of the twin screened cable must be earthed at one end only, and this may be accomplished using the Locking DIN plug body/clamp, of a Mustang amplifier. No hum loop will result.
Similarly, the middle example of Fig. 12 will not give rise to a hum loop, and whilst it is not a strictly balanced connection, the output is considered to be 'floating' with the signal earths of the two units not directly connected.

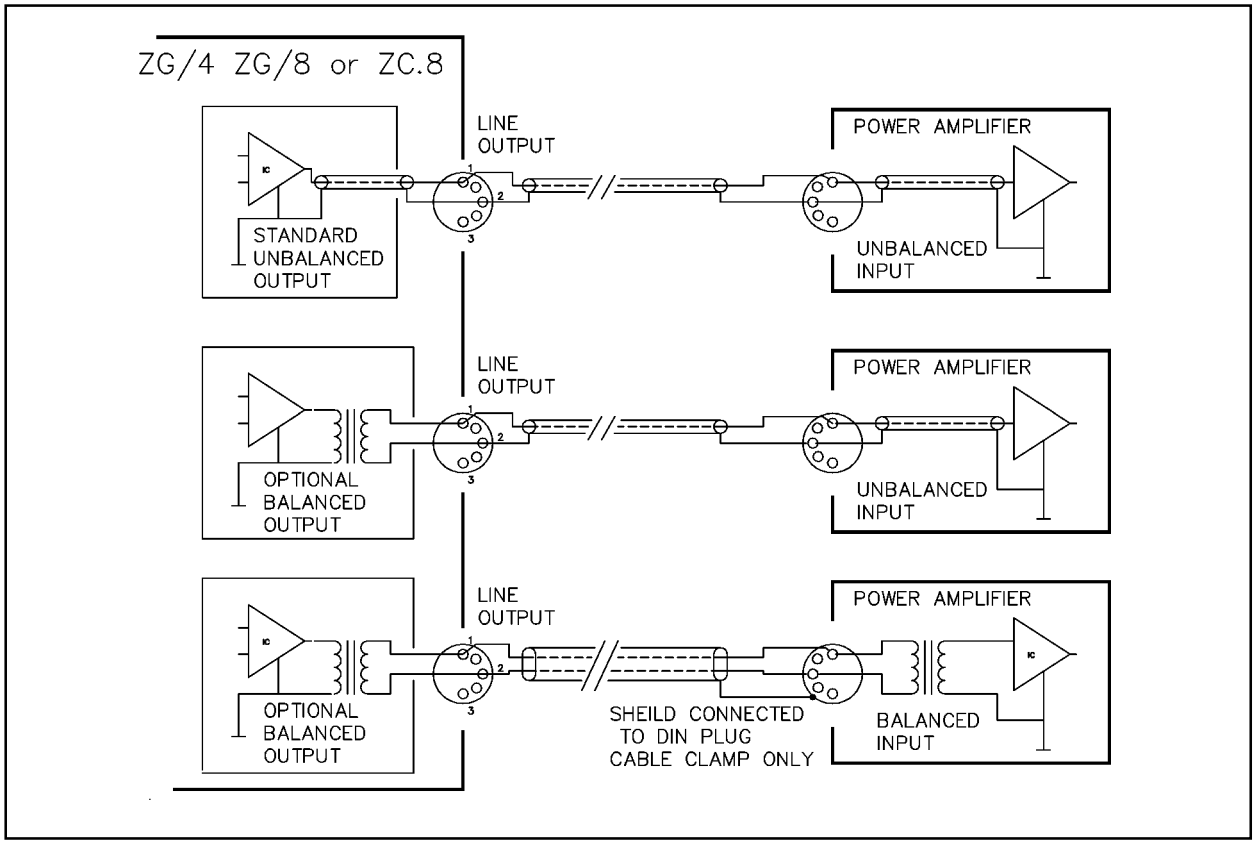


Fig. 12 Unbalanced and balanced line output connections

Automatic level control - ZG units only
Mustang product code TB/ALC

The standard module fitted to a ZG/4 or ZG/8 unit to provide line driver facilities is a TB.6 and is located second from the right on the input pre-amplifier section mother PCB when viewed from the front. This is replaced with a TB.6A to provide the Automatic level control facility (ALC) and it will enable the system to be set up such that a pre-settable amplitude cannot be exceeded. All signals that would normally pass through the amplifier circuitry are subject to automatic level control operation.
The module operates to produce a fast "attack" so that limiting to a pre-determined level takes place almost instantly, and a slow "decay" whereby the sensitivity - or gain - is allowed to increase progressively over several seconds or until another limit is triggered.
To set the module to give the required performance: Firstly, referring to APPENDIX E, identify the 'GAIN' pre-set control which is adjacent to the integrated circuit at the left of the board approximately half way up. Then identify the 'THRESHOLD' pre-set control which is a little below it. Set the Master Level control on the mother PCB to maximum (see Fig.1 on page 7).
Setting Turn the GAIN pre-set fully anti-clockwise to give approximately unity gain. Now, whilst running the amplifier system at full volume using a test signal, adjust the THRESHOLD to the desired maximum output level indicated by the output meter. Clockwise adjustment increases the threshold level. The threshold is adjustable from -24 dBM to +8dBM.
The module will now be operating as a limiter. To enable the Automatic Level Control aspect, the GAIN control should now be adjusted clockwise until sufficient gain is available to enable the lowest level input signal to attain the THRESHOLD.

The ALC facility will have been specified where -

a) The controller output is required to be limited to prevent clipping distortion in subsequent amplification;
b) The average sound level is to be limited to a specific audible level;
c) Inductive loop systems which may be unattended though still need to operate to the requirements of the current legislation.

As supplied by the factory, GAIN is set to 0dB (unity) and the THRESHOLD control is set to maximum, and therefore no effect will initially be apparent.
See APPENDIX D to locate the module, and APPENDIX E for identification of the adjustments.

INSTALLATION

Selection of signal input cables
It is essential that input connections are made carefully, using appropriate screened cable, soldered to DIN connector plugs, and using the appropriate terminal numbers indicated in the section describing the input modules in this manual. Unscreened "telephone" type cables are NOT suitable. Either twin conductor, or single conductor types may be used depending upon the application. For long fixed cable runs, a cable with a conventionally braided outer shield is preferable to a lap-screened type. A conductive plastic shield type is ideal for cables which will be subject to constant flexing such as those connected directly to microphones. Failure to meet these requirements will result in inferior performance, and at worst, damage to the amplifier.
It is not possible in this manual to be specific about the exact types of input cable for use in any particular amplification system, as many practical factors will need to be taken into account. However, as a guide, we would recommend the following:

Balanced lines should be wired in twin, twisted core, screened cable with a conductor size of at least 0.22sq.mm., and preferably 0.5sq.mm. This is equally valid for dynamic or phantom-powered microphones, and line inputs.
Paging microphone lines will need an extra two conductors to operate the priority circuit of the amplifier. These need not be screened. For short runs, (up to 2 Metres), paging microphones may be connected using 4-core overall screened cable, and for longer runs, (up to 10 Mtrs), 4-core individually screened cable. If it is necessary to run a cable over say 10 Mtrs, then there may be some performance advantage in using a separate twin-twisted screened cable for the audio, and a separate twin unscreened cable for the priority operate cores.
Line level cables, such as those between a tape recorder and the zone controller, which may be up to a few metres in length are less critical and may be run using lap-screened, single or twin cable with conductors of 7/0.1mm or 7./0.2mm.

Rack mounting
This is accomplished by the use of the optional extra rack mount kit - Mustang part No. BRK-30 which provides heavy duty mounting ears and contoured 'pull handles' which screw to the sides of the unit and form an extension to the front panel. It is also necessary to remove the self-adhesive feet to avoid fouling the unit below. The units occupy 3U of standard 19" panel space. If individual units are each supported by chassis runners - Mustang part No. CR.LNP then they may be stacked contiguously, though read the issues regarding ventilation, below. Never rack mount a unit without using runners or some other horizontal support.
Select a rack cubicle design which does not cover the ventilation slots in either side of the chassis.

Top cover removal
Disconnect the power source(s). Remove the countersunk screws and lift the cover clear. It is connected to the chassis by a clip-on safety earth which MUST be re-connected when refitting the lid. Always re-fit the cover and do not over-tighten the screws.

Fitting Locking DIN connectors
Signal input connections are made via a locking DIN 5-pin plug (Mustang Code 5-180). To insert:- rotate the plug until the pins line up with the corresponding socket contacts, and push fully in. Rotate the locking ring clockwise to secure. Similar plugs used for domestic Hi-Fi systems may be used though they are generally of inferior quality, and have a weaker cable clamp with no locking facility.
When connecting the input cables to the locking DIN plugs, it is most important to observe the following:-

a. DO NOT allow the cable braiding/shield to contact the cable clamp, plug body or fixing screw. An earth/hum loop will result. This topic is fully covered on page 21.
b. Application of silicon grease to the cable outer sleeve will facilitate easy insertion into the grommet.
c. Be careful when soldering. Avoid bridging adjacent pins of the locking DIN connectors with solder. If pins 4 and 5 are not to be used, break them off to provide extra space for soldering.

Interference

In accordance with EMC regulations, steps have been taken in the designs of the range to minimise interference from external sources. The main possibilities would be -

a) faulty or insufficiently suppressed lighting dimmer
b) incorrectly shielded or earthed lighting dimmer
c) lighting dimmer lines close to signal input lines
d) strong radio/TV transmission immediately adjacent
e) faulty fluorescent tubes or tube fittings
f) unsuppressed heavy electrical contacts
g) stray magnetic fields from other mains equipment adjacent
h) computer, calculator, or related equipment adjacent

The source of interference should be established by elimination and logic, and equipment repaired or modified accordingly, rather than attempting modifications to the amplification or control equipment.

Removal of control knobs - ZG units

Removable control knobs are fitted to ZG/4 and ZG/8 units to deter tampering. Remove simply by pulling firmly away from the front panel. Do not use a twisting motion. The knobs will detach easily but the spindles have a spline feature within the potentiometer body and are a tight fit. Ideally, twist a small screwdriver blade between the shoulder of the spindle and the potentiometer body inside the unit. The panel holes may be plugged using the blanking plugs supplied. They are a push-clip fit and cannot be removed from outside the amplifier. The knobs and spindles may be replaced at any time.

Checklist

During the commissioning of the controllers in the MACRO range, various options are available to the engineer to enable him to meet various technical requirements and the operating requirements of the user:

Ensure input modules set for priority operation (ZG)
Individual input module sensitivity adjustment (ZG)
Bass cut on microphone input module (ZG)
Pre-announcement chime level (ZG)
Timer setting of tone generator modules (ZG)
Current sink facilities to remote relays, and microphone zone keys
Adjustment of Aux/priority audio gains controls of output modules
Setting of zone group pre-selector switches (ZG)
Optional auto level control adjustment (ZG)
Control knobs to be removed (ZG)

FUSES

Fuses for the protection of both the AC and DC supplies are located on the rear panel. The AC supply input fuse is part of the IEC inlet and is accessed by firstly removing the cable plug from the unit and then, by using a small screwdriver to unclip the fuse carrierfrom the fixed part of the connector. As shipped from the factory, a spare fuse is supplied within this carrier.
Certain fuses are contained within the chassis of MACRO ZG controllers rather than on accessible front/rear panels:

(A) F1A pre-amplifier DC fuse on the pre-amplifier stabiliser module
(B) F1A auxiliary DC fuse on the PMB.12 Power Management Board

See APPENDIX D and APPENDIX E for identification.
Failure of the top fuse (A) could indicate a problem in the stabiliser module or within the subsequent mixer circuitry. The lower fuse (B) protects the Auxiliary +24V DC output (pin 12 of the 'D' connector). It is rated at 1 Amp and if this supply is used to source current for the priority current sinks, then these may have been damaged by the overload. These sinks are located and each priority input module, and on each buffer output module.
If a fuse blows repeatedly, a fault is indicated. Do not attempt to force the amplifier by fitting larger fuses. All standard fuses should be replaced as a matter of routine every year if in regular use.
When replacing fuses, disconnect the mains supply and allow a few minutes for capacitors to discharge.

FAULTS - SYMPTOMS AND CHECKLIST

The following list of fault symptoms and check points cannot be considered as comprehensive, but as a guide to the most likely faults and causes. We assume that the input sources, amplifiers, and loudspeakers are properly connected and in good working order. Be sure to check these carefully first before investigating the controller.

FAULT SYMPTOM	CHECKLIST
1. Sound off, POWER LED off	AC mains fuse, mainslead, mains power, mains switch. DC supply, fuse, or leads.
2. Sound off, POWER LED on	Internal AC/DC power fuses, input connections module edge connectors, pre-amplifier stabiliser module, line driver module, input and/or output priority channel not being triggered, attempt to use input module in non-priority mode, input module not being set by dedicated jumper pins, input module being muted by operation of higher priority
3. Sound faint	Module sensitivity adjustment, incorrect output connections, overload on mixer facility socket, incorrect input pin selection, incorrect choice of input module.
4. Sound loud but distorted	Incorrect choice of input module, incorrect module sensitivity setting or pin selection, volume control too far advanced, system requires amplifier of greater power or more efficient loudspeakers, master control set too low.
5. Sound distorted on bass peaks	Bass controls too high, poor quality 100V line loudspeaker transformers. See also No.4 above.
6. Sound distorted and low	Incorrect choice of input module, incorrect module sensitivity setting or pin selection, master control set too low, incorrect setting of output module aux. audio gain adjustment, output module not being triggered.
7. Case gets very hot	Power supply transforme, insufficient ventilation, case vents covered.
8. Parasitic/supersonic oscillation	Insufficient screening on high sensitivity input signal cables, insufficient earthing, loudspeaker/input leads adjacent or parallel for some length, unloaded input line, incoming parasitic on signal line from ancillary equipment, braiding on input cable disconnected or intermittently faulty.
9. Soft hum - gain controls down	Earth/hum loop - see page 21, power supply capacitor failing, induced magnetic field from nearby mains equipment.
10. Hum	Incoming hum from ancillary equipment, induced hum on sensitive input cables, incorrect earthing to amplifier or ancillary equipment, earth/hum loop, see page 21
11. Hiss	Excess treble, signal noise incoming from ancillary equipment, unloaded input signal line, noisy input module.
12. Fizz	Interference from lighting dimmers, dimmer lines, faulty fluorescent lights, earth/hum loop, see page 21
13. Loud harsh hum or buzz	Disconnected signal input braiding, earth/hum loop, see page 21
14. Intermittent loud cracking	Strained input module edge connectors, dirty edge connectors, intermittent input lead connections, dirty mains plug pins, loose mains fuse, radiated interference from thermostat etc. see also No.5 above.
15. Mains line fuse blowing	Mains switch suppressor shorted, main rectifier failed, mains transformer failed.
16. Input channel off	Incorrect priority triggering, module edge connector, module muted by higher priority, input signal fault, module not set to passive mode
17. Incorrect input signal priority	Incorrect setting of PCB priority switches or of priority/passive jumpers
18. Incorrect output signal priority	Incorrect triggering via Auxiliary Input, incorrect setting of zone group pre-selector DIL switches, incorrect interconnection of input sink-microphone zone selection switch-auxiliary input control.
19. Incorrect zone groups	Incorrect connection to Auxiliary Input connector, pre-selector switches require setting
20. Some current sinks inoperative	Current sinks damaged, output priority not being triggered, sink connections.
21. All current sinks inoperative	Current sinks damaged, output priority not being triggered, sink connections, failure of +DC source, internal DC fuse on regulator module.
22. Intermittent sound	Strained input module or driver board edge connector, fractured input cable, worn volume control track.
23. AC supply fuse blowing	Regulator module
24. POWER LED unlit	AC (and/or DC) power missing, power fuses.
25. Disparity of output levels between zones or music/priority	Gain adjustments on output modules incorrectly set, incorrect triggering of output modules, incorrect line output plug connections.

REPAIRS AND MAINTENANCE

Should components be required for replacement purposes, these may be obtained without delay from the address on the cover of this manual. It would be preferable to use original specification components rather than improvise or modify the amplifier.

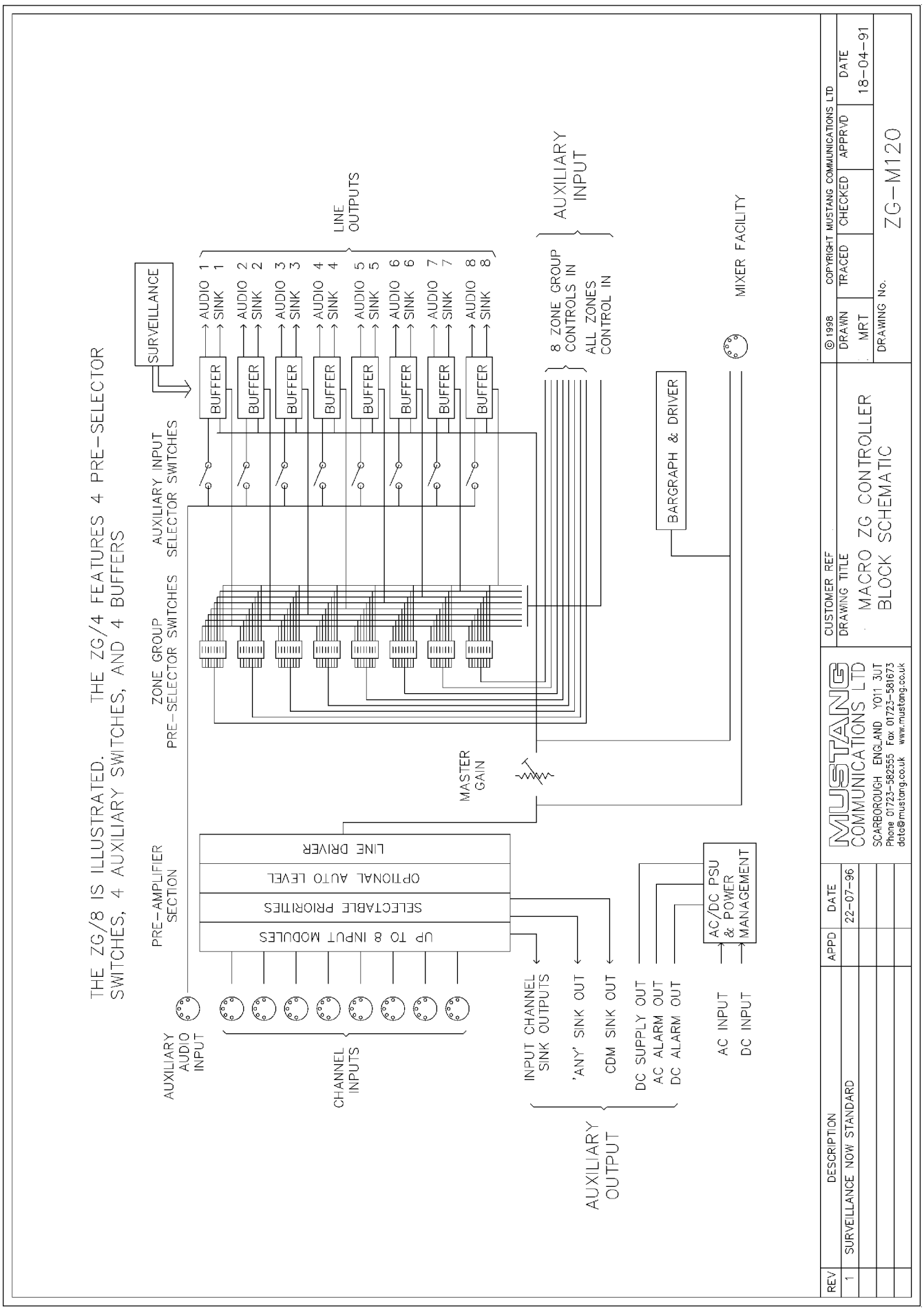
The MACRO range of amplification products has been planned so that servicing and maintenance is extremely uncomplicated. All main potential sources of failure are either pluggable or accessible from the top of the main circuit boards. It is unlikely that the main board will ever need to be removed except for the removal of spilled liquid, or broken mechanical parts. However, should this be necessary proceed as follows:
Remove the gain control knobs and associated spindles by pulling firmly. Remove all the modules. Spring in the 8 plastic support pillars, spaced along the board. By lifting the rear edge of the board it will now be possible to push the board backwards and upwards giving access to the bottom of this board. De-solder the signal cableform if complete access is required.

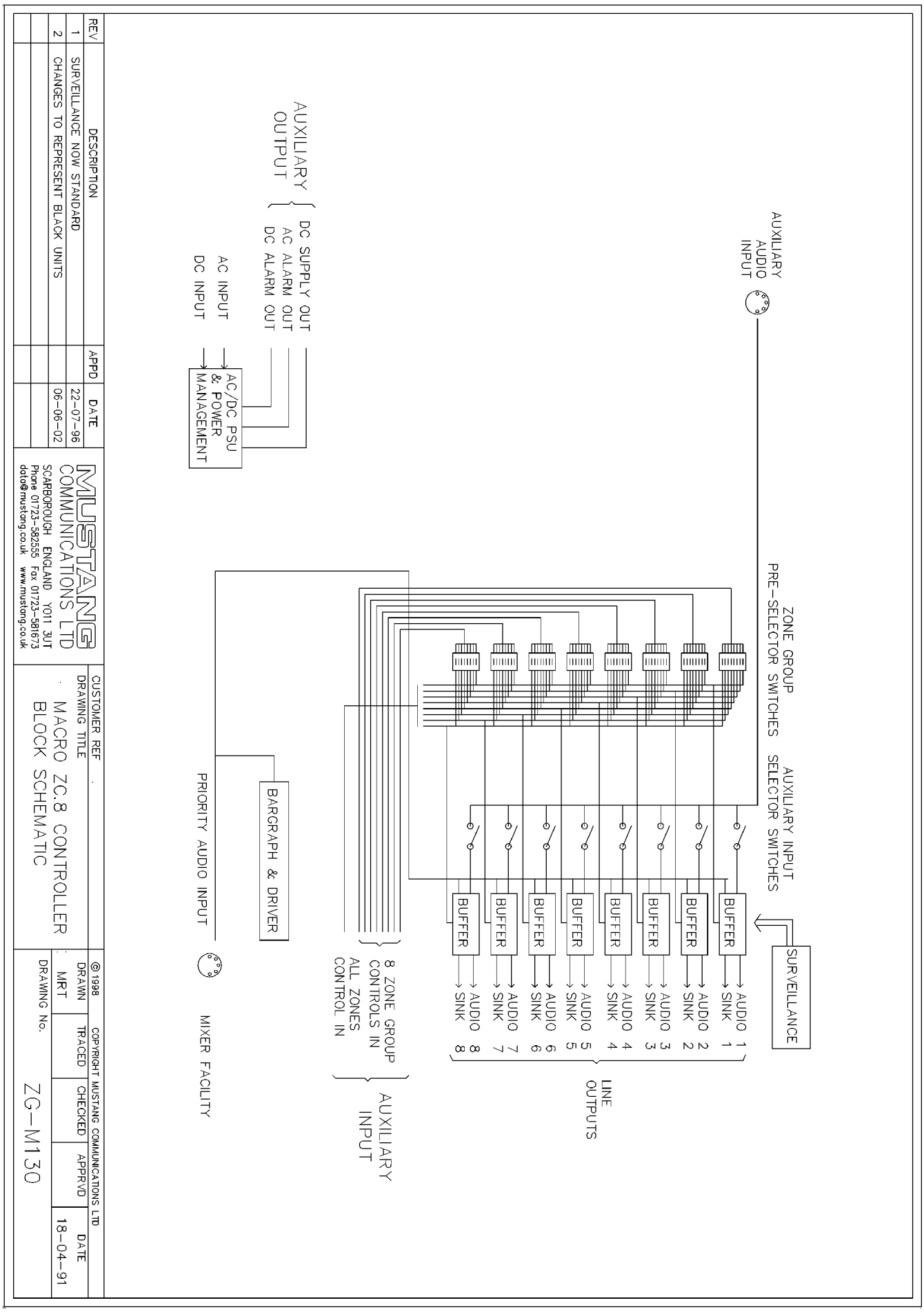
WARRANTY

This unit should operate successfully for many years if installed correctly. However, should a fault occur within 24 months of installation, whilst the unit has been operated within its specification, the manufacturer undertakes to replace parts, or the whole unit, at their discretion, free of all labour or parts charges. However, should investigation of such a fault indicate operation of the unit outside its specification, then the manufacturer reserves the right to levy an appropriate repair charge.
Should a fault be suspected, your dealer should be notified in the first instance. All returns should be made via your dealer, forward carriage paid, and be accompanied by details of:

a the reported symptoms
b brief details of the installation.
c details of the circumstances of failure

Following the routine warranty period, Mustang amplifiers may be returned via your dealer, to the manufacturer for any necessary repairs or refurbishing. Details of the work required/reported fault must accompany the unit, and nominal charges will be levied.


THE ZG/8 IS ILLUSTRATED. THE ZG/4 FEATURES 4 PRE-SELECTOR SWITCHES, 4 AUXILIARY SWITCHES, AND 4 BUFFERS
PRE-AMPLIFIER SECTION
ZONE GROUP PRE-SELECTOR SWITCHES
AUXILIARY INPUT SELECTOR SWITCHES
SURVEILLANCE
LINE OUTPUTS
AUDIO 1 SINK 1
AUDIO 2 SINK 2
AUDIO 3 SINK 3
AUDIO 4 SINK 4
AUDIO 5 SINK 5
AUDIO 6 SINK 6
AUDIO 7 SINK 7
AUDIO 8 SINK 8
BUFFER
8 ZONE GROUP CONTROLS IN
ALL ZONES CONTROL IN
AUXILIARY INPUT
MIXER FACILITY
BARGRAPH & DRIVER
MASTER GAIN
UP TO 8 INPUT MODULES
SELECTABLE PRIORITIES
OPTIONAL AUTO LEVEL
LINE DRIVER
AUXILIARY AUDIO INPUT
CHANNEL INPUTS
INPUT CHANNEL SINK OUTPUTS
'ANY' SINK OUT
CDM SINK OUT
DC SUPPLY OUT
AC ALARM OUT
DC ALARM OUT
AUXILIARY OUTPUT
AC INPUT
DC INPUT
AC/DC PSU & POWER MANAGEMENT
REV
DESCRIPTION
APPD
DATE
1
SURVEILLANCE NOW STANDARD
22-07-96
MUSTANG COMMUNICATIONS LTD
SCARBOROUGH ENGLAND YO11 3UT
Phone 01723-582555 Fax 01723-581673
data@mustang.co.uk www.mustang.co.uk
CUSTOMER REF
DRAWING TITLE
MACRO ZG CONTROLLER
BLOCK SCHEMATIC
© 1998 COPYRIGHT MUSTANG COMMUNICATIONS LTD
DRAWN
TRACED
CHECKED
APPRVD
DATE
MRT
18-04-91
DRAWING No.
ZG-M120



REV	DESCRIPTION	APPD	DATE
1	SURVEILLANCE NOW STANDARD		22-07-96
2	CHANGES TO REPRESENT BLACK UNITS		06-06-02

MUSTANG COMMUNICATIONS LTD
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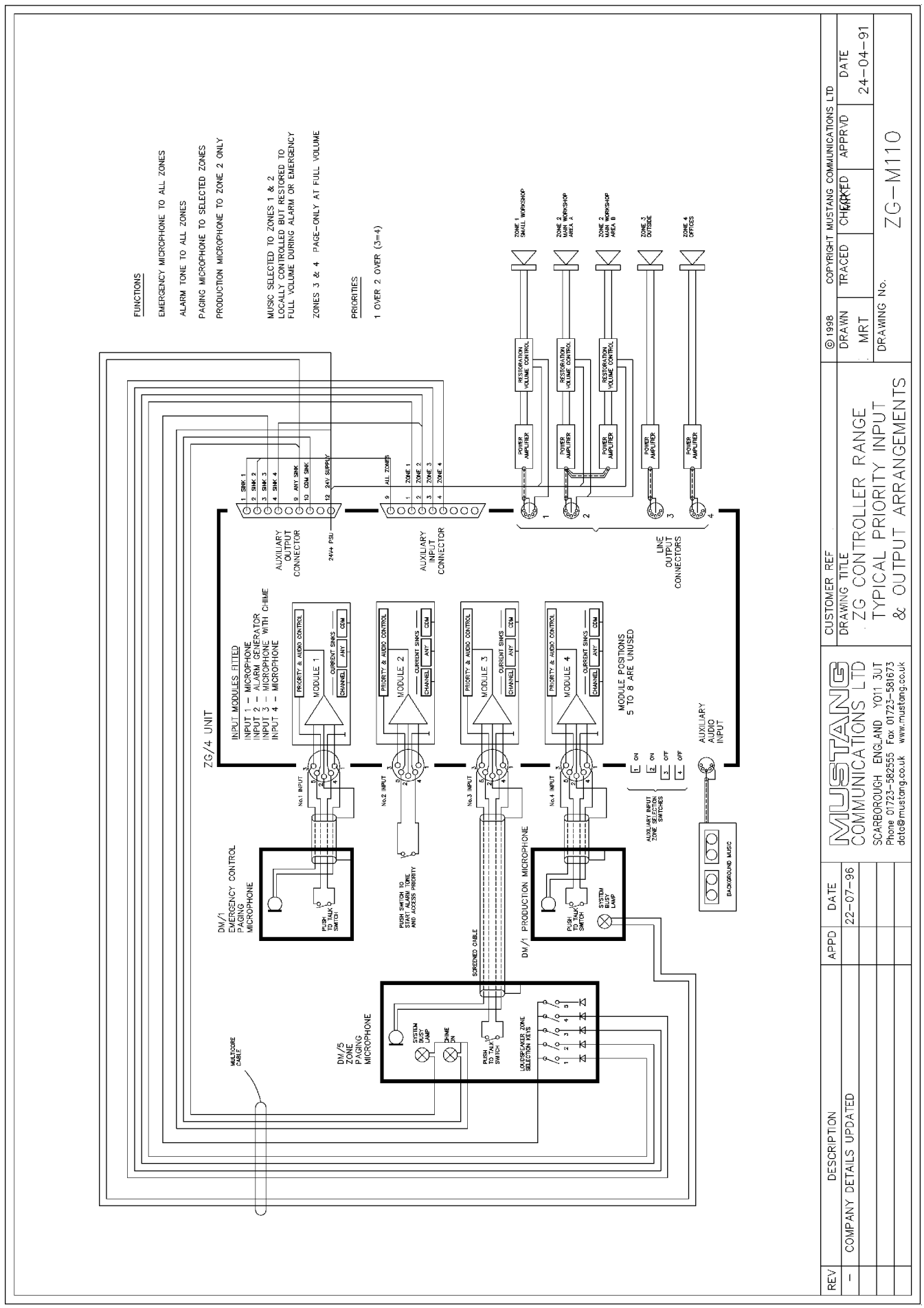
Phone 01723-582555 Fax 01723-581673
data@mustang.co.uk www.mustang.co.uk

CUSTOMER REF.

DRAWING TITLE
MACRO ZC.8 CONTROLLER
BLOCK SCHEMATIC

DRAWN	TRACED	CHECKED	APPRVD	DATE
MRT				18-04-91

DRAWING No. ZG-M130



REV	DESCRIPTION	APPD	DATE
–	COMPANY DETAILS UPDATED		22-07-96

MUSTANG COMMUNICATIONS LTD
SCARBOROUGH ENGLAND YO11 3UT
Phone 01723-582555 Fax 01723-581673
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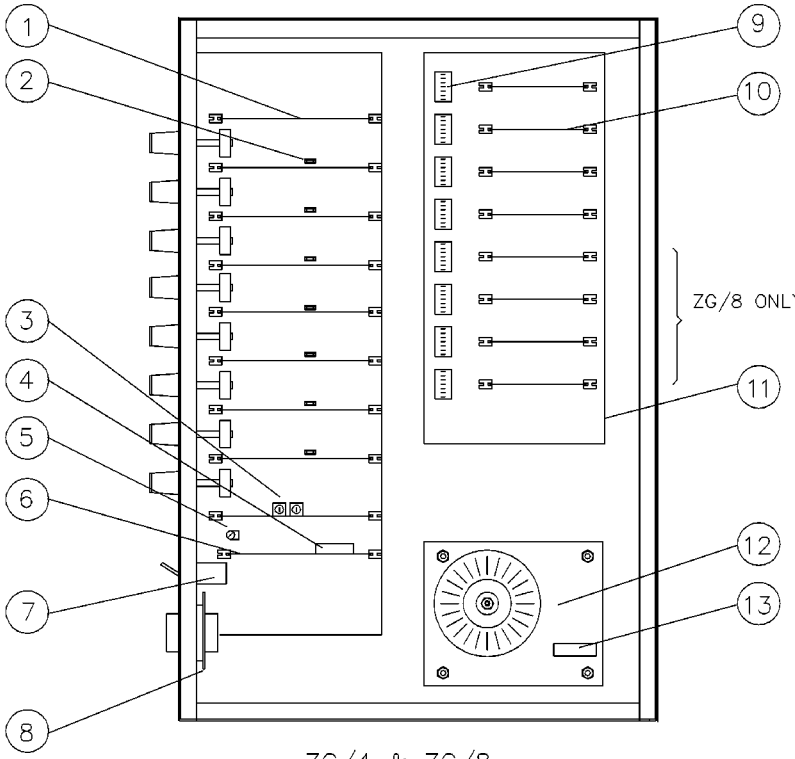
CUSTOMER REF

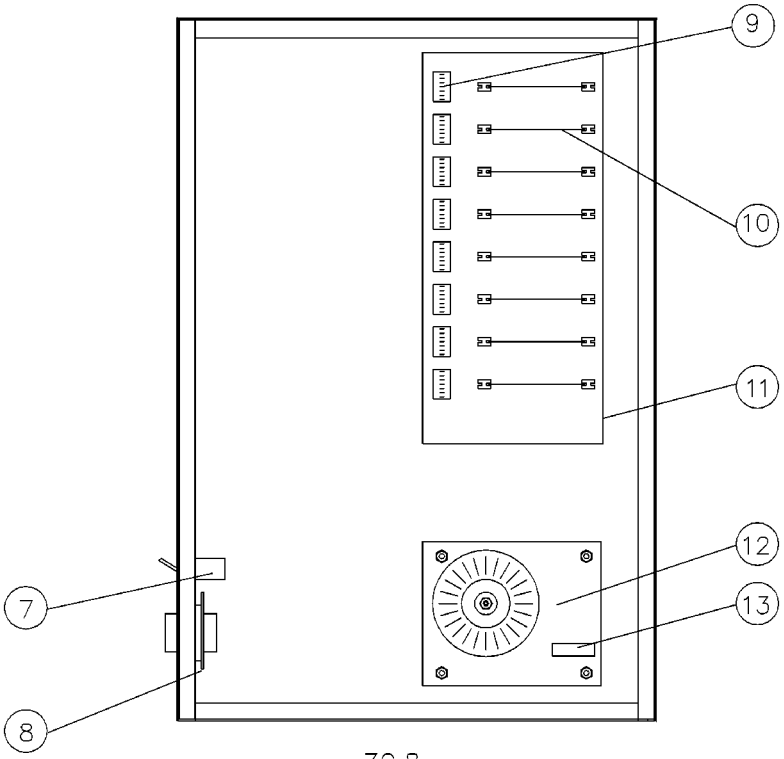
DRAWING TITLE
ZG CONTROLLER RANGE
TYPICAL PRIORITY INPUT
& OUTPUT ARRANGEMENTS

DRAWN	TRACED	CHECKED	APPRVD	DATE
MRT				24-04-91

DRAWING No. ZG–M110



ZG/4 & ZG/8



ZC.8

1 INPUT MODULE No. 1
2 PRIORITY CONTROL JUMPER
3 TREBLE (ON RIGHT) & BASS CONTROLS
4 PRE-AMPLIFIER DC FUSE
5 MASTER GAIN CONTROL
6 POWER SUPPLY STABILISER MODULE
7 AUXILIARY INPUT SELECTOR SWITCHES
8 BARGRAPH & BARGRAPH DRIVER PCB
9 GROUP PRE-SELECTOR SWITCH No. 1 for example
10 OUTPUT MODULE No. 2 for example
11 OUTPUT SECTION MOTHER PCB
12 POWER MANAGEMENT PCB
13 AUX DC FUSE

REV	DESCRIPTION	APPD	DATE
–	COMPANY DETAILS UPDATED		22-07-96
1	CHANGES TO REPRESENT BLACK UNITS		06-06-02

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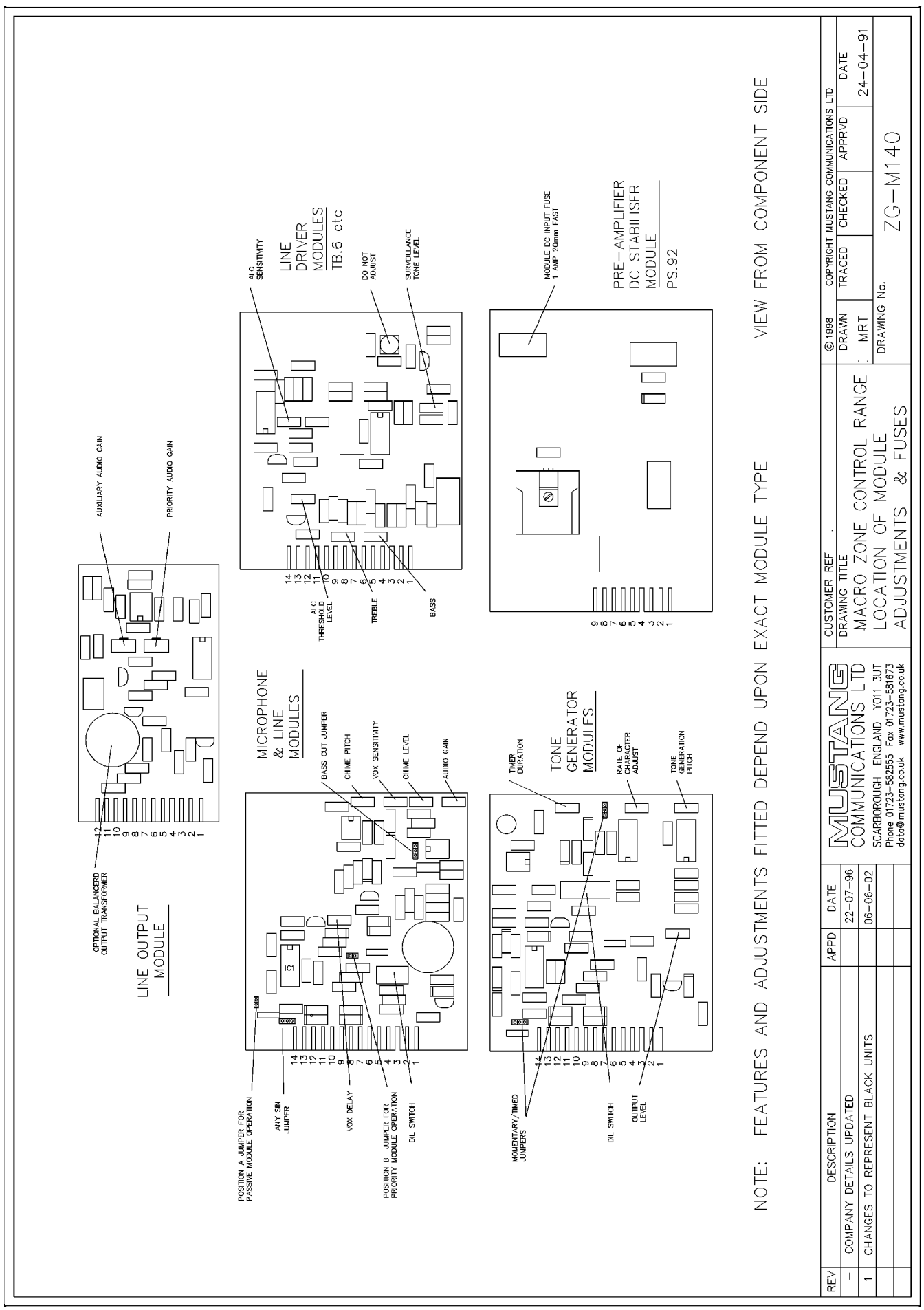
CUSTOMER REF .

DRAWING TITLE
MACRO ZONE CONTROL RANGE
MAIN COMPONENT
IDENTIFICATION

DRAWN	TRACED	CHECKED	APPRVD	DATE
MRT				18-04-91

DRAWING No. ZG-M100



REV	DESCRIPTION	APPD	DATE
–	COMPANY DETAILS UPDATED		22-07-96
1	CHANGES TO REPRESENT BLACK UNITS		06-06-02

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CUSTOMER REF
DRAWING TITLE
MACRO ZONE CONTROL RANGE
LOCATION OF MODULE
ADJUSTMENTS & FUSES

DRAWN	TRACED	CHECKED	APPRVD	DATE
MRT				24-04-91

DRAWING No. ZG-M140