MUSTANG
COMMUNICATIONS

GA AMPLIFICATION RANGE

INSTALLATION & MAINTENANCE HANDBOOK

Issue No.5

SCOPE OF THIS ISSUE:

GM.3, GTM.3
GMA.703 GTMA.703
GMA.1403, GTMA.1403
GMA.2803, GTMA.2803
A.140, A.280
Input modules
Standard option

Mustang Communications Ltd
Eastfield Industrial Estate
Scarborough
England
YO11 3UT

Telephone U.K. 01723 582 555
Telephone International 44 1723 582 555

Fax U.K. 01723 581 673
Fax international 44 1723 581 673

Email infor@mustang.co.uk
Web www.mustang.co.uk

Author: M. R. Tetley M. Inst. S. C. E.

INDEX

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, or European standard ISO.9000. If you have cause to doubt at any time that the design, 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 Managing Director.

The equipment and its applications

The Mustang GA range is a modular amplification system designed specifically for use in industrial environments, and provides facilities for the operation of paging microphones, alarm tones, times pips, etc. in various orders of priority, in addition to an auxiliary non priority input which would normally be used for a music source. Each of these input facilities would normally be referred to as Channels 1, 2, 3 and 4 respectively. Each of these input signals is accepted by the amplifier by a dedicated but removable circuit module selected from the list on page 7. Thus, signals of any type or characteristic may be processed in accordance with the environmental operating priorities of a particular installation.
GA amplifiers provide up to 4 inputs - of which 3 are priority in either descending sequence or equal access mode, or a combination of both, and the amplifiers are capable of 50 watt, 100 watt, or 200 watt outputs. Each unit may be connected to low impedance or 100 Volt/50Volt line loads, and secondary output connections are provided for dedicated loudspeaker circuits which require to be energised only during paging or priority messages. Additional 100W and 200W slave amplifiers may be incorporated into a system design to provide increased power output capability.
GA amplifier models are available which will accommodate dedicated radio tuner modules. AM and/or VHF FM programs are selectable by a simple front panel switch which may be set to select up to 4 VHF programs and/or one AM station, or an auxiliary input signal which could be an alternative music source. The GA circuitry is arranged such that should any “priority” input be accessed then the “music signals are temporarily muted. For installations where more than 3 priority signals are required, additional mixers from the GA range may be incorporated in the design and the priority sequences will be maintained.
To render the GA range even more versatile, control signals are available from the amplifiers, upon operation of individual priority channels. Those control signals may operate loudspeaker switching circuitry and volume restoration relays, in specific zones associated with time pips, paging announcements, etc. “System busy” lamps may also be controlled.
The front panel of the 200 Watt units features display of output level and operational status indication.
All the units in the range are available either as rack mounting or free-standing versions.

In use the amplifiers 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.

By appropriate choice of input modules, the GA range of equipment 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

GENERAL SPECIFICATIONS

MIXER AMPLIFIERS	GMA.703 GTMA.703	GMA.1403 GTMA.1403	GMA.2803 GTMA.2803
Input channels - GMA units	3 priority & 1 non-priority		
Input channels - GTMA units	3 priority & 1 non-priority & 2 tuners		
Tuner module capacity (GTMA only)	1 AM module (provides 1 fixed station) 1 VHF FM module (provides 4 stations)		
Input channel level & response	dependent upon input modules fitted		
Treble & Bass adjustment	+/- 12dB @ 100Hz & 10kHz ref.1kHz		
Power output (Watts RMS contin.)	50	100	200
Current sink	500mA maximum, each of 3 channels		
Auxiliary DC	nominally +24V		
Mixer facility level	775mV nominal. 0dBV		
Power amplifier input	775mV , 0dBV @ 22k ohms		
Power amplifier power freq. resp.	-3dB @ 20Hz & 20kHz ref. 1kHz, low imp -3dB @ 20Hz & 18kHz ref. 1kHz, 100V		
Loudspeaker matching	100V/50V line balanced, & low impedance		
AC mains input	240V 50-60Hz +5% -15%		

SLAVE AMPLIFIERS	A.140	A.280
Power output (Watts RMS contin.)	100	200
Audio input level	775mV, 0dBV @ 22k ohms	
Power amplifier power freq. resp.	-3dB @ 20Hz & 20kHz ref. 1kHz, low imp -3dB @ 20Hz & 18kHz ref. 1kHz, 100V	
Loudspeaker matching	100V/50V line balanced, & low impedance	
AC mains input	240V 50-60Hz +5% -15%	

MIXERS	GM.3	GTM.3
Input channels - GM units	3 priority & 1 non-priority	
Input channels - GTM units	3 priority & 1 non-priority & 2 tuners	
Tuner module capacity (GTM only)	1 AM module (provides 1 fixed station) 1 VHF FM module (provides 4 stations)	
Input level & response	dependent upon input modules fitted	
Treble & Bass adjustment	+/- 12dB @ 100Hz & 10kHz ref.1kHz	
Current sinks	500mA maximum, each of 3 channels	
Auxiliary DC	nominally +24V	
Audio output level	775mV nominal. 0dBV	
AC mains input	240V 50-60Hz +5% -15%	

FRONT PANEL CONTROLS AND INDICATORS

The front panel controls have been positioned and identified so that they may be easily understood by non-technical operators. Each input channel is fitted with a volume (gain) control graduated 0 to 10. These numbers are entirely arbitrary and enable accurate re-setting, though position 10 gives the maximum system gain for that input. Internal controls are provided for amplifier master gain, treble cut/lift, and bass cut/lift as shown in APPENDIX D, though these are set up on installation and should not normally be adjusted without consulting your dealer. If less than the full number of input modules is fitted to the amplifier, the setting of the spare controls will not effect its output.
Inputs 1, 2, and 3 are priority channels and need to be triggered “on” before gain adjustments can be made. Similarly, input 4 (music) will be muted during any priority operation of inputs 1, 2, or 3.

The “music” gain control (input 4) works in conjunction with the music selector switch (fitted only to GTM.3 and GTMA amplifiers). This switch can select one program only, as per the following table -

SELECTOR POSITION	PROGRAM	MODULE REQUIREMENT	MODULE POSITION
AUX	Program entering the amplifier via AUX music socket at the rear	any module from standard range to suit signal	4
E	AM radio (fixed	XAM.2	5
D - C - B - A	4 VHF radio stations which have been set up on installation. See page 15	VFM.3	6

Table 1. Music selector switch functions and associated modules

Spindle locks if fitted are intended to defeat unauthorised tampering. To make adjustments, carefully slacken the hexagonal nut and turn the central control shaft using a screwdriver blade.
A series of indicators provides a simple means of assuring the user of correct amplifier operation. Amplifiers in all ranges feature an illuminated mains switch to indicate that mains power is reaching the internal circuitry. Failure to illuminate will indicate one of the following:-

a) no mains power to the amplifier
b) AC mains fuse on the rear panel has failed

Failure a) could be the result of a faulty electrical installation or even failure of a fuse in the mains plug, whereas failure b) would indicate likelihood of amplifier internal problems or short-circuited loudspeaker lines.
GMA.2803, GTMA.2803 and A.280 amplifiers also feature three additional LED systems. The 10 segment ladder gives an indication of output level expressed in dB - i.e. decibels 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 amplifier output is zero. If the illuminated segment is predominantly to the extreme right (maximum) then it is likely that the amplifier is being over-driven and that the resulting sound will be distorted on peaks. Reduce the corresponding front input gain control accordingly.
Two small LEDs indicate operational status. A steady green “normal” lamp shows the amplifier is connected to the loudspeaker load and operating correctly. A delay of approximately 3 seconds from power-on is normal and is incorporated to provide time for the amplifier to settle and thus ensures silent start-up. The “hot” red lamp flashes only in the event of amplifier overheating and may be a result of loudspeaker lines being faulty. At this point the “normal” lamp extinguishes and the loudspeakers are disconnected until the amplifier cools sufficiently for this protection circuitry to reset automatically. The system integrity is lost in such a circumstance and FOR AN ALARM OR SECURITY INSTALLATION THE CONSEQUENCES COULD BE SERIOUS. Evidence of such indication should be investigated by a competent engineer IMMEDIATELY.

TONE CONTROL & MASTER GAIN ADJUSTMENT - not relevant to A.140 or A.280 units

TONE CONTROLS Pre-settable adjustments are provided for treble/cut lift and bass cut/lift. For their locations and respective settings to achieve flat response see APPENDIX D. To increase treble or bass responses rotate the controls clockwise (earlier models were anti-clockwise).
MASTER GAIN See APPENDIX D for location of this pre-settable adjustment. Normally this will leave the factory in the full gain position. Rotate anti-clockwise to reduce gain to zero (earlier models were clockwise).

INPUT MODULE SYSTEM - not relevant to A.140 or A.280 units

The input module system designed for use with Mustang GA, MMA, VA, and MDS amplifiers provides facilities for the connection of any item of ancillary equipment, and incorporates the correct amount of tonal correction or equalisation where appropriate. As part of the range, tone generator modules are available featuring time delayed and/or instantaneous triggering where appropriate. Similarly, full-feature radio tuner modules are available, which in certain installations can render unnecessary the provision of a separate tuner unit.

Module installation
Any of the modules from the published list may be used in any of the input channels of the amplifiers although if priority operation is required, this will necessitate using the appropriate module in a designated priority module position. With the GA range, this will be positions 1 2 or 3.
The GA, MMA, VA and MDS amplifiers 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 may 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. 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 22

b. Application of silicone 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.

INPUT MODULES, CONNECTIONS & OPERATION

MODULE	FUNCTION
M.60	Multi-purpose balanced microphone & line, with phantom DC supply
M.60TB	Multi-purpose balanced mic/line, phantom DC. Treble & bass adjustment
L.50	Multi-purpose high level balanced line
M.6	Microphone 30-200 ohms, transformer balanced , with phantom supply
QM.6	Microphone 30-200 ohms, transformer balanced, three-tone chime, phantom supply
G.4	Phono-turntable pick-up with RIAA ceramic/magnetic equalisation
T.5	Line input, wide range sensitivity, unbalanced general purpose
L.5	Line input, transformer balanced, medium to high level input
TG.2	Tone generator - 1kHz tone pips and continuous tone
TG.3	Tone generator - 1kHz gongs
TG.5	Tone generator - Warble alarm and Dee-Dah alarm
XAM.2	Tuner, AM, fixed single station
VFM.3	Tuner, VHF. for use with GTMA and GTM units.
	Module developments
PM.6	Phantom powered microphone module. Facilities now incorporated into standard M.6 module
CM.6	Two-tone chime microphone module. Superceded by QM.6 three-tone chime
M.7	Microphone - high impedance. Obsolete
TG.1	Continuous sine wave tone generator. Facilities now incorporated into standard TG.2 module
TG.4	Tone generator - Dee-dah alternating alarm. Facilities now incorporated into standard TG.5 module

Table 1. The current range of input modules

M.60 & M.60TB Multi-purpose microphone & Line modules with phantom supply

These modules feature a high quality input transformer for balanced microphone or line operation. They may be used with conventional dynamic microphones, or phantom powered microphones and line level devices.
The M.60TB consists of an M.60 microphone module together with a sandwiched treble/bass card. A Baxendall derived circuit offers independent adjustment of treble and bass frequencies - both cut and lift. The adjustments are accessible from the top of the module.
The modules feature continuously variable sensitivity between low impedance microphone level and 0dB line level, by means of a GAIN trimmer and switchable attenuators, and is set at despatch to 1mV sensitivity. Other switch functions include:-

- ON/OFF stabilised +15 volt supply for use with phantom microphones or pre-amplified microphones
- ON/OFF bass-cut switch to enhance speech clarity for paging and similar applications, or for amplification through horn loudspeakers.
- ON/OFF earth lift for assisting with earth-loop problems.

The sensitivity (GAIN) control pre-set is located at the top of the module and may be operated by a small screwdriver. Rotate clockwise to increase sensitivity. Rotate the treble and bass controls to increases sensitivity. The centre position of each adjuster represents approximately flat response.
The PCB also includes two 4-pole DIL switches to cover all settings. DIL-A may be identified at the top of the module adjacent to the gain trimmer, whilst DIL-B is at the bottom. The switch poles are numbered on each switch body and the “ON” position is also shown. The various switch bars may be operated by the use of a small pointed instrument, ball-pen, etc.

Standard Locking DIN input socket connections

Pin 1	in phase	Balanced input
Pin 2	signal earth	
Pin 3	out of phase	
Pin 4	0V	
Pin 5	Priority control operate	(Priority channel only)

DO NOT allow the cable braiding to contact the cable grip of the DIN connector, or a earth/hum loop will result, and interference suppression may be impaired. See elsewhere in this manual for further details of priority facilities and operation.

SPECIFICATION

Input configuration	Transformer balanced. Centre tap may be switched free of earth.
Sensitivity	Variable 125uV @ 600 ohms to 2.6V @ 4k ohms by switch settings and trimmer.
Input overload margin	Nominally 35dB
Frequency response	-3dB @ 30Hz and 20kHz ref 1kHz
Treble & bass adjustm.	+/- 12dB @ 100Hz and 10kHz (M.60TB only)
Signal to noise ratio	Nominally 60dB @ 1mV
Bass-cut facility	Roll-off of approximately 6dB per octave below 200Hz. Switchable in/out
Phantom supply	+15V stabilised. Feeds via 2k7 ohm to each line. Factory set null. Switchable on/off.

M.60 & M.60TB DIL Switch functions

	DIL-A				DIL-B			
	1	2	3	4	1	2	3	4
Sensitivity variable 125uV - 2mV	off	on			off		on	on
Sensitivity variable 2mV - 20mV	on	off			off		on	on
Sensitivity variable 20mV - 300mV	on	off			off		off	off
Sensitivity variable 300mV - 2.6V	on	off			on		off	off
Bass cut filter in circuit				off				
Bass cut filter out of circuit				on				
Phantom supply on			on			on		
Phantom supply off			off					
Input transformer centre tap to earth						on		
Input transformer free of earth						off		

L.50 Multi-purpose high-level line module

This module features a high quality input transformer for balanced microphone or line operation. It may be used with a variety of input sources such as music equipment, remote amplification, and line level devices, etc. The module features continuously variable sensitivity by means of a gain trimmer and switchable attenuators, and is set at despatch to 775mV sensitivity. Other switch functions include:-

- ON/OFF bass-cut switch to enhance speech clarity for paging and similar applications, or for amplification through horn loudspeakers.
- ON/OFF earth lift for assisting with earth-loop problems.

A sensitivity (GAIN) control pre-set is located at the top of the module and may be operated by a small screwdriver. Rotate clockwise to increase sensitivity.

The PCB also includes 2 four-pole DIL switches to cover all settings. DIL-A may be identified at the top of the module adjacent to the gain trimmer, whilst DIL-B is at the bottom. The switch poles are numbered on each switch body and the “ON” position is also shown. The various switch bars may be operated by the use of a small pointed instrument, ball-pen, etc.

SPECIFICATION

Input configuration	Transformer balanced. Centre tap may be switched free of earth.
Frequency response	-3dB @ 30Hz and 20kHz ref 1kHz
Sensitivity	Variable 75mV to 100V @ 10k ohms by switch settings and trimmer.
Input overload margin	Nominally 32dB
Signal to noise ratio	Nominally 66dB @ maximum sensitivity
Bass-cut facility	Roll-off of approximately 6dB per octave below 200Hz. Switchable in/out

Standard Locking DIN input socket connections

Pin 1	in phase	Balanced input
Pin 2	signal earth	
Pin 3	out of phase	
Pin 4	0V	(Priority channel only)
Pin 5	Priority control operate	

DO NOT allow the cable braiding to contact the cable grip of the DIN connector, or a earth/hum loop will result, and interference suppression may be impaired.

See elsewhere in this manual for further details of priority facilities and operation.

L.50 DIL Switch functions

	DIL-A				DIL-B			
	1	2	3	4	1	2	3	4
Sensitivity variable 50mV - 600mV	on	on				off	off	
Sensitivity variable 500mV - 6V	on	on				on	off	
Sensitivity variable 6V - 100V	on	on				off	on	
Bass cut filter in circuit				off				
Bass cut filter out of circuit				on				
Input transformer centre tap to earth								on
Input transformer free of earth								off

M.6 Low impedance microphone module with Phantom supply (Later versions - M.6-2 onwards)

This module features a high quality input transformer for balanced line operation of dynamic microphones between 30 ohms and 600 ohms impedance, combined with a highly stable +15V DC supply for phantom powering of microphones. This facility was previously featured only in the PM.6 module.

The sensitivity is continuously variable by means of a trimmer resistor. Be careful to use a very small screwdriver blade. This control is marked “Gain” and is rotated anti-clockwise to increase sensitivity. When supplied, the gain is set to minimum (1mV for 200/600 ohm microphones) and should only be altered if found to be essential for correct operation. This will avoid prematurely overdriving the module into clipping distortion on peaks of sound. DO NOT force this control or intermittency will result. Generally an increase in gain will be necessary for 30ohm microphones.

On the component side of the board are three Molex style jumper sets. These operate as links which can be repostioned to enable/ disable various functions. Gently pull off the plastic bodied link and re-postion it on to the two pins adjacent to the required function, as follows:

PHANTOM When postioned in the OFF position, the module is for use with a conventional dynamic balanced microphone. In the ON position, (and with the 0V link in the Phantom position - see below) the phantom supply is energised. Dynamic microphones may still be used with the phantom supply operating, and without damage, though connection noises may occur if microphones are plugged/ unplugged.

It will normally be necessary to reduce the “gain” of this module, too, for correct phantom operation.

BASS CUT If the jumper is repositioned to the BASS CUT location, then the specified bass roll-off will be enabled. Its operation is suitable for enhancing speech clarity for paging and similar applications, or for amplification through horn loudspeakers.

0V LIFT In the NORMAL position, the transformer is conventionally balanced about 0V. In the PHANTOM postion, the configuration is for balanced phantom supply and must be in this position (with the PHANTOM jumper also set to ON) for phantom powering to be enabled.

If this jumper is removed completely (or parked on one pin only) and the Phantom jumper set to OFF, then the configuartion is dynamic balanced floating, which may be useful where signal earth conflicts are being experienced. This is occasionally referred to as “lifting the earth”.

Standard Locking DIN input socket connections

Pin 1 in phase audio (& +15V DC Phantom power)
Pin 2 0V return (cable braid) } Balanced input
Pin 3 out of phase audio (& +15V DC Phantom power)
Pin 4 0V
Pin 5 Priority control operate } (Priority channel only)

DO NOT allow the cable braiding to contact the cable grip of the DIN connector, or a earth/hum loop will result, and interference suppression may be impaired. See elsewhere in this manual for further details of priority facilities and operation.

SPECIFICATION

Input configuration	Transformer balanced. Centre tap optionally to 0V by pin header & jumper link
Phantom supply	Optionally, by pin header and jumper link: 15V DC stabilised. Factory set null.
Sensitivity	Variable 100uV @ 30 ohms to 1mV @ 200 ohms.
Input overload margin	46dB to 26dB
Frequency response	-3dB @ 55Hz and 20kHz ref 1kHz
Signal to noise ratio	Nominally 60dB @ 1mV
Bass cut	Optionally, by pin header and jumper link: Roll-off of approximately 6dB per octave below 200Hz

PM.6 Combined low impedance microphone and phantom DC supply

The PM.6 module is fully superceded by the standard M.6 module (from issue M.6-2 onwards). The PM.6 module is described here for completeness.

This module offers a high performance transformer balanced input combined with a highly stable +15 Volt DC supply for the phantom powering of microphones.

Standard Locking DIN input socket connections

Pin 1	in phase audio (& +15V DC)	Balanced input
Pin 2	0V return (cable braid)	
Pin 3	out of phase audio (& +15V DC)	
Pin 4	0V	(Priority channel only)
Pin 5	Priority control operate	

DO NOT allow the cable braiding to contact the cable grip of the DIN connector, or a earth/hum loop will result, and interference suppression may be impaired.
See elsewhere in this manual for further details of priority facilities and operation.

SPECIFICATION

Input configuration	Transformer balanced. Primary side held at +15V above signal earth by on board stabiliser and feed resistor to each input leg. Factory set DC balancing. Signal earth to amplifier input socket.
Sensitivity	Variable 100uV @ 30 ohms to 1mV @ 200 ohms.
Input overload margin	46dB to 26dB
Frequency response	-3dB @ 55Hz and 20kHz ref 1kHz
Signal to noise ratio	nominally 60dB @ 1mV
Bass cut option	Cut green wire link to introduce bass roll-off of approximately 6dB per octave below 200Hz

CM.6 Combined low impedance microphone module and ding-dong chime
CM.6 has been generally superceded by QM.6 module, and the following details are to assist maintenance and service requirements. Original details and assistance are freely available by contacting our service department.

The CM.6 consisted of an original specification M.6 module combined with a two-tone chime generator board.
Please note that the original specification M.6 did not feature phantom powering, molex jumpers for bass-cut or 0V earth lift.
The green wire link for the bass cut is located on the print side of the board. The flying lead of the CM.6 should be connected to the printed circuit board pin marked "- trigger" adjacent to the module rear support on the main circuit board. This is the trigger connection and operates simultaneously with priority access and therefore the CM.6 should always be used in a priority module position. Injection of the "ding-dong" signal relative to the microphone signal is adjusted by the small trimmer resistor marked "INJECTION" and the best setting will be found by experiment.
The trimmer resistor on the chime PCB marked "PITCH" adjusts both the speed and pitch of the chime sequence simultaneously.

Standard Locking DIN input socket connections

Pin 1	in phase audio	Balanced input
Pin 2	Signal earth	
Pin 3	out of phase audio	
Pin 4	0V	(Priority channel only)
Pin 5	Priority control operate	(Priority channel only)

DO NOT allow the cable braiding to contact the cable grip of the DIN connector, or a earth/hum loop will result, and interference suppression may be impaired.
See elsewhere in this manual for further details of priority facilities and operation.

SPECIFICATION

Input configuration	Transformer balanced. Centre tap to signal earth on module, and to amplifier input socket.
SensitivityVariable	100uV @ 30 ohms to 1mV @ 200 ohms.
Input overload margin	46dB to 26dB
Frequency response	-3dB @ 55Hz and 20kHz ref 1kHz
Signal to noise ratio	nominally 60dB @ 1mV
Bass cut option	Cut green wire link to introduce bass roll-off of approximately 6dB per octave below 200Hz
Chime frequencies	Variable - approximately 1000/888Hz
Chime duration	Variable - approximately 2 seconds

QM.6 Combined low impedance microphone module, triple chime, and phantom supply (from issue QM.6-1 onwards)

This consists of a version of an M.6 module combined with a three-tone chime generator board.
For information on gain adjustment, bass cut, 0V earth lift, phantom supply, etc., see M.6 details above. The flying lead of the QM.6 should be connected to the printed circuit board pin marked "- trigger" adjacent to the module rear support on the main circuit board. This is the trigger connection and operates simultaneously with priority access and therefore the QM.6 should always be used in a priority module position. Injection of the "ding-dang-dong" signal relative to the microphone signal is adjusted by the small trimmer resistor marked "CHIME INJECT" and the best setting will be found by experiment.
The trimmer resistor on the chime PCB marked "CHIME PITCH" adjusts both the speed and pitch of the chime sequence simultaneously.

Standard Locking DIN input socket connections

Pin 1	in phase	Balanced input
Pin 2	signal earth	
Pin 3	out of phase	
Pin 4	0V	(Priority channel only)
Pin 5	Priority con trol operate	

DO NOT allow the cable braiding to contact the cable grip of the DIN connector, or a earth/hum loop will result, and interference suppression may be impaired.
See elsewhere in this manual for further details of priority facilities and operation.

SPECIFICATION

Input configuration	Transformer balanced. Centre tap to signal earth on module, and to amplifier input socket.
Sensitivity	Variable 100uV @ 30 ohms to 1mV @ 200 ohms.
Input overload margin	46dB to 26dB
Frequency response	-3dB @ 55Hz and 20kHz ref 1kHz
Signal to noise ratio	nominally 60dB @ 1mV
Bass cut	Optionally, by pin header and jumper link: Roll-off of approximately 6dB per octave below 200Hz
Chime frequencies	Variable - approximately 1000/888/626Hz
Chime duration	Variable - approximately 2.5 seconds

M.7 High impedance microphone/general purpose module

This module is obsolete, but shown here for completeness
This module is for use either with high impedance microphone or ancillary sound sources with low level equalised outputs. Two pre-set sensitivities are available, selected by two alternative connections at the input socket. The 50mV connections would normally be used either for microphones or low output tape head pre-amplification etc. The 15mV connections provides extra sensitivity but as with all input modules this could lead to early onset of clipping distortion on peaks of sound if care is not exercised. The green wire link on the component side of the board provides a bass cut filter if cut. Its attenuation is approximately 3dB per octave below 200Hz and is suitable for enhancing speech clarity for paging and similar applications, or for amplification through horn loudspeakers. Bend the cut ends of the link apart to prevent accidental contact.

Standard Locking DIN input socket connections

Pin 1	50mV (.05V) input	
Pin 2	signal earth (cable braiding)	
Pin 3	15mV (.015V) input	
Pin 4	0V	
Pin 5	Priority control operate	(Priority channel only)

DO NOT allow the cable braiding to contact the cable grip of the DIN connector, or a earth/hum loop will result, and interference suppression may be impaired.
See elsewhere in this manual for details of priority facilities and operation.

SPECIFICATION

Input configuration	Unbalanced audio relative to signal earth
Sensitivity	Selectable at input socket 15mV @ 33k ohm or 50mV @ 47k ohm
Input overload margin	26dB
Frequency response	-3dB @ 55Hz and -1dB 20kHz ref 1kHz
Signal to noise ratio	Nominally 60dB
Bass cut option	Cut green wire link to introduce bass roll-off of approximately 6dB per octave below 200Hz

G.4 Magnetic and ceramic pick-up module for record players

This module is a variable sensitivity module suitable for mono or stereo magnetic or ceramic (crystal) pick-ups. The sensitivity when supplied is set to minimum - "C" (suitable for ceramic cartridges) by means of the small trimmer resistor. By rotating the control carefully anti-clockwise by means of a very small screwdriver blade towards the "M" position, the sensitivity will increase to a level suitable for magnetic cartridges. DO NOT force this control or intermittency will result. Be careful to establish the type of cartridge in use and adjust the module accordingly. If incorrectly determined, the result will be either exceptionally low or high amplification of the signal. In the latter case severe distortion will arise and the front volume control operation will probably be cramped between position 0 and 1. Be careful to maintain the correct stereo signal phasing on the input plug, as, if the left and right signals are out of phase the result will be strangely hollow and un-natural amplification with distortion. Always adjust the trimmer resistor to the minimum sensitivity possible for normal operation of the front volume control.

Standard Locking DIN input socket connections

Pin 1	input left or right or mono
Pin 2	signal earth (cable braiding)
Pin 3	input left or right or mono

DO NOT allow the cable braiding to contact the cable grip of the DIN connector, or a earth/hum loop will result, and interference suppression may be impaired.

SPECIFICATION

Input configuration	Two unbalanced audio inputs, passively mixed relative to signal earth.
Sensitivity	Variable 4mV to 90mV @ 47k ohm.
Equalisation	RIAA
Input overload margin	47dB to 68dB @ 1kHz
Signal to noise ratio	60dB to 68dB

T.5 CD/Tape/Radio general purpose unbalanced line input module
(from issue T.5-1 onwards)

This module would be selected for use with most tape players, radio tuner units, mixers, pre-amplifiers, etc., with output signal levels of between 50mV and 5V. Two pre-set sensitivities are provided by alternative connections at the input socket and the equipment manufacturers handbook should be consulted to determine the most suitable connection. A variable level control provides a further 20dB of attenuation. The 50mV connections would not normally be used for signal levels greater than approximately .75Volt as the input overload margin would be exceeded leading to premature clipping distortion on sound peaks.

Standard Locking DIN input socket connections

Pin 1 775mV input (variable 500mV - 5V)
Pin 2 signal earth (cable braiding)
Pin 3 50mV input (variable 50mV - 500mV)
Pin 4 0V (Priority channel only)
Pin 5 Priority control operate (Priority channel only)

DO NOT allow the cable braiding to contact the cable grip of the DIN connector, or a earth/hum loop will result, and interference suppression may be impaired. See elsewhere in this manual for further details of priority facilities and operation.

SPECIFICATION

Input configuration	Two unbalanced audio inputs relative to signal earth, unmixed.
Sensitivity	Selectable at input socket 50mV @ 47k ohm or 775mV @ 400k ohm
Level control	20dB additional attenuation. Factory set at 0dB attenuation
Input overload margin	26dB (46dB)
Frequency response	-3dB @ 20Hz and -1dB 25kHz ref 1kHz
Signal to noise ratio	nominally 65dB (85dB)

L.5 Balanced floating line input module
(from issue L.5-1 onwards)

This module would be selected for use with sound mixers and zero level output (775mV nominally), amplifier loudspeaker outputs, and existing loudspeaker line systems up to 100V. One particularly useful feature is that the input connections are totally free of earth thereby automatically preventing earthing and earth/hum loop problems. A Level control and two general sensitivity ranges are provided by alternative connections at the input socket and the equipment manufacturers handbook or the installation contractor should be consulted to determine the most suitable connection. The 250mV-2.5V connection would NOT NORMALLY be used with amplifiers EXCEEDING the following ratings -

15 Volt line output i.e. 50/70/100V
15 watts into 16 ohms
30 watts into 8 ohms
55 watts into 4 ohms

No damage is likely to be caused to the module if these ratings are exceeded though distortion will tend to occur on sound peaks. If in doubt, use the 3.5V-42V connection. The loading provided by the L.5 module is negligible.

Standard Locking DIN input socket connections

Pin 1	3.5V - 42V input	floating
Pin 2		free of
Pin 3	300mV - 3.5V input	earth
Pin 4	0V	
Pin 5	Priority control operate	(Priority channel only)

See elsewhere in this manual for further details of priority facilities and operation.

SPECIFICATION

Input configuration	Dual sensitivity, transformer balanced, floatings.
Sensitivity	Selectable at input socket 0.3V-3.5V @ 10k ohm or 3.5V-42V @ 150k ohm
Input overload margin	30dB (50dB)
Frequency response	-3dB @ 30Hz and -1dB 20kHz ref 1kHz
Signal to noise ratio	nominally 85dB (105dB)

TG.1 Sine wave tone generator
The TG.1 module is fully superceded by the standard TG.2 module (from issue TG.2-1 onwards). The TG.1 module is described for completeness.
This module is useful for the setting up and matching of sound system components, or it may be used as an alarm tone. External triggering may be enabled by connection of a distant “make” switch to the tone trigger pin and signal earth pin at the Locking DIN input socket, or alternatively the module may be internally triggered by bridging a wire link between the two pins on the module itself. The tone will be generated for the duration of the “make” switch contact, and as the external triggering is at a very low current level, the cable used to connect it need only by a very light duty twin conductor of any length.

Standard Locking DIN input socket connections

Pin 1 Tone trigger
Pin 2 signal earth
Pin 3 1V RMS auxiliary signal output
Pin 4 0V (Priority channel only)
Pin 5 Priority control operate (Priority channel only)

See page 16 for further details of priority facilities and operation.
Pins 5 and 1 may be connected together to provide simultaneous triggering and priority operation, when returned to 0V

SPECIFICATION

Tone character	Uninterrupted sine wave
Triggering	On PCB or external make switch
Tone duration	Duration of trigger
Auxiliary output	1V RMS @ 47k ohm
Adjustment	Tone pitch 750-1350Hz

TG.2 1kHz time pips and test-tone generator (later versions - TG.2-1 onwards)
The TG.2 module now incorporates the facilities of the earlier TG.1 module.

This module is triggered externally via the appropriate channel by any pair of “make” switch contacts. Either continuous pips or a series of up to 10 pips or a continuous tone or tone burst may be triggered depending on the connections and jumper settings. The pip group or tone burst may be triggered by momentary or permanent switch contacts. Triggering takes place at a very low current level and the cable may be of any length and of very light duty twin conductor type. The PITCH of the tonemay be adjusted by the trimmer on the module, using a very small screwdriver blade. DO NOT force this control.

Standard Locking DIN input socket connections

Pin 1 trigger for continuous pips or uninterrupted tone
Pin 2 signal earth
Pin 3 trigger for one group of of pips, or for tone burst
Pin 4 0V (Priority channel only)
Pin 5 Priority control operate (Priority channel only)

See page 16 for further details of priority facilities and operation.
Pins 5 and 1 (or 3) may be connected together to provide simultaneous triggering and priority operation, when returned to 0V

SPECIFICATION

Tone character	Continuous 1kHz sine wave tone or interrupted 1kHz sine wave. 100mS on, 900mS off.
Triggering	External make switch, momentary or continuous
Tone duration	Duration of continuous trigger, or approximately up to seconds single cycle for momentary.
Timer	Duration of group of pips or of tone burst set by TIMER trimmer approximately 1second to 10 seconds
Pitch adjustment	Approximately 750-1350Hz
Mode Selection	Pips or uninterrupted tone by Molex style pin header and jumper

TG.3 Repeating gong generator (later versions - from issue TG.3-1 onwards)

This module is triggered externally via the appropriate channel by any pair of make contacts. Either continuous gongs or up to 10 seconds of gongs may be triggered depending on the connections. The timed duration of gongs may be triggered by momentary or permanent switch contacts. Triggering takes place at a very low current level and the cable may be of any length and of very light duty twin conductor type. The frequency of oscillation may be adjusted by the trimmer resistor on the module, using a very small screwdriver blade. DO NOT force this control.

Standard Locking DIN input socket connections

Pin 1 Continuous trigger for gongs
Pin 2 Signal earth
Pin 3 Momentary trigger for timed group of gongs
Pin 4 0V (Priority channel only)
Pin 5 Priority control operate (Priority channel only)

See page 16 for further details of priority facilities and operation.
Pins 5 and 1 (or 3) may be connected together to provide simultaneous triggering and priority operation, when returned to 0V

SPECIFICATION

Tone character	1kHz gongs at 1 second intervals
Triggering	External make switch, momentary or continuous
Tone duration	Continous gongs for duration of continuous trigger, or a timed single group of gongs using momentary trigger.
Timer adjustment	Approximately 1 second to 10 seconds by PCB trimmer
Pitch adjustment	Approximately 750-1350Hz

TG.4 Alternating alarm tone generator

The TG.4 module is fully superceded by the standard TG.5 module (from issue TG.5-1 onwards). The TG.4 module is described for completeness.

This module is triggered externally via the appropriate channel input socket by any pair of "make" switch contacts connected between the trigger and signal earth pins of the Locking DIN input socket. The alarm signal will be generated for the duration of trigger contact and as triggering takes place at a very low current level, the cable may be of any length and of very light duty twin conductor type.
Whenever the alarm generator is operating, an auxiliary signal output will appear at the input connector. The frequencies of oscillation are adjusted by the trimmer resistor on the module. Use a very small screwdriver blade and DO NOT force this control.

Standard Locking DIN input socket connections

Pin 1 trigger
Pin 2 signal earth
Pin 3 1V RMS auxiliary signal output
Pin 4 0V (Priority channel only)
Pin 5 Priority control operate (Priority channel only)

See page 16 for further details of priority facilities and operation.
Pins 5 and 1 may be connected together to provide simultaneous triggering and priority operation, when returned to 0V

SPECIFICATION

TG.4 Tone character	Alternating fixed frequency tones of 1000Hz & 700Hz approximately, at 0.5 second intervals
Triggering	External momentary make switch
Tone duration	Duration of trigger
Auxiliary output	1V RMS @ 33k ohm
Adjustment	Tone pitch

TG.5 Warble and Dee-Dah alarm tone generator (later versions - from issue TG.5-1 onwards)

This modules now also incorporates the features originally provided by the TG.4 module.
The TG.5 is triggered externally via the appropriate channel input socket by any pair of "make" switch contacts connected between the trigger and signal earth pins of the Locking DIN input socket. The alarm signal will be generated for the duration of trigger contact and as triggering takes place at a very low current level, the cable may be of any length and of very light duty twin conductor type.
Whenever the alarm generator is operating, an auxiliary signal output will appear at the input connector. The frequencies of oscillation are adjusted by the trimmer resistor on the module. Use a very small screwdriver blade and DO NOT force this control.

Standard Locking DIN input socket connections

Pin 1 trigger
Pin 2 signal earth
Pin 3 1V RMS auxiliary signal output
Pin 4 0V (Priority channel only)
Pin 5 Priority control operate (Priority channel only)

See page 16 for further details of priority facilities and operation.
Pins 5 and 1 may be connected together to provide simultaneous triggering and priority operation, when returned to 0V

SPECIFICATION

Dee-Dah tone character	Alternating fixed frequency tones of 1000Hz & 700Hz approximately, at 0.5 second intervals
Warble tone character	Single tone sweeping between 1000Hz & 700Hz approximately, on a 0.25 second continuous cycle
Triggering	External momentary make switch
Tone duration	Duration of trigger
Auxiliary output	1V RMS @ 33k ohm
Adjustments	Tone pitch Speed of Warble/Dee-dah
Tone selection	By Molex type pin header and jumper on PCB: Dee-dah or Warble

TUNER MODULES - GTM.3 and GTMA units only

XAM.2 AM Single station tuner

This circuit module is a completely self-contained crystal-controlled, AM radio tuner incorporating RF, IF, and AF amplification, two RF tuned circuits to aid image rejection, a ceramic filter for greater selectivity, an IF rejection filter, AGC, and a control to pre-set the AF output.
The crystal oscillator used in this circuit commits the module to the reception of one station only, and all tuned circuits are set on manufacture to optimise on performance at this frequency. Therefore no adjustments except to the AF output pre-set resistor should be made.
For optimum results, the antenna system should be fitted with a 75 ohm downlead which will connect directly to amplifiers with a standard 75 ohm coax antenna socket.

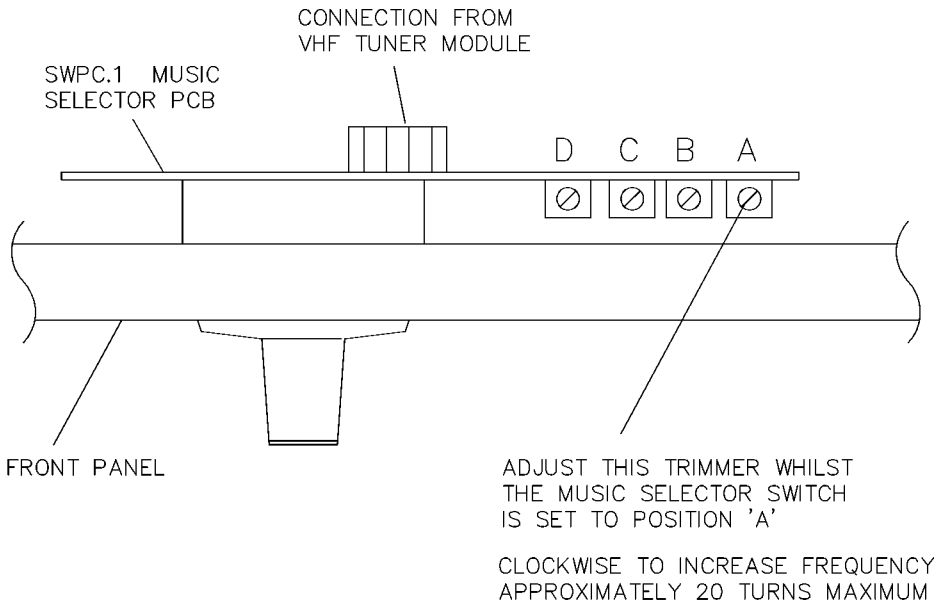


Fig.1 Location of the VHF station adjusters

To assist in setting the system up, a signal strength arbitrary voltage test pin is located at the top rear. Tune or orientate the antenna for the highest reading.

SPECIFICATION
Input configuration Fixed frequency radio tuner system, in the range 1.5MHz to 600kHz. Factory set.
Sensitivity Better than 6uV @ 75 ohms for 26dB S/N
Controls Audio gain
Features Automatic RF/IF gain control
Quad tuned 470kHz IF
Double tuned RF pre-selector

VFM.3 VHF/FM Multi-station station tuner

This module is designed for use with the dedicated station selector PCB which is factory fitted to dedicated tuner amplifiers. This PCB features 4 helical potentiometers which are used to set the desired stations.
The module must be used in the dedicated VHF tuner module socket, and the connection cable links to the selector PCB.
For optimum results, a proprietary VHF antenna system should be used, complete with 75 ohm downlead. The amplifier will feature a standard coax socket.
Construction is of two circuit boards mounted back to back on which is contained a complete tunable VHF radio tuner, including RF, IF, and AF amplification, FM demodulation, AGC, variable squelch, supply stabilisation, and AFC. User adjustments are provided for variable squelch, and AF output, and all other adjustments are factory set. Connection pins are provided for the purpose of disabling the AFC to assist initial tuning of weak stations. Upon manufacture, the squelch is adjusted such that this is defeated by signals greater than 8uV, ensuring full attenuation of RF noise when the transmitting station closes down.

SPECIFICATION
Input configuration Voltage tuned VHF radio tuner system, for the range 88MHz to 108MHz. External selection. 75 ohm input.
Sensitivity Better than 3uV @ 75 ohms for 40dB S/N
Image rejection 70dB
AGC threshold Operates for signals greater than 25uV
AFC capture limits 250kHz @ 25uV
Module adjustments Audio gain
Squelch - factory set to 8uV

Installation & adjustment of tuner modules - GTM.3 and GTMA units only

The AM and VHF modules described above are inserted into module positions 5 and 6 respectively, and antenna signals from the rear coaxial socket are routed via a splitter PCB to these dedicated positions.
The AM module is crystal controlled and therefore has no adjustments for frequency. The VHF module, in conjunction with the front panel music selector switch can provide up to 4 programs. To tune into a station, set the selector switch to position A and adjust the corresponding helical pre-set resistor on the selector PCB, until the required station is located. This multi-turn adjuster is mounted on the extreme right of the PCB on which the selector switch is mounted, inside the amplifier. See Fig.1 Adjustment is clockwise to increase frequency up to 108MHz and anti-clockwise to lower frequency to 88MHz. Repeat this process for each switch position.

It is normally necessary to tune to the centre frequency of the required VHF station and this is most easily accomplished by shorting the two PCB pins at the top of the VHF module in order to defeat the AFC, for each tuning operation. Now, by turning the pre-set carefully a position will be found where the station is received without distortion. Removing the short will re-instate AFC and account for frequency drift caused by temperature change etc. It is possible that when attempting to tune a weak station, which is transmitting on a frequency adjacent to a much stronger station, that the AFC when re-instated will cause the module to lock onto the stronger station.
There are two possible ways of overcoming this:- firstly by the use of a more directional antenna beamed at the weaker station.

Alternatively, it should be possible to de-tune to the opposite side of the weak station. In any event, check that the tuner locks onto the correct station by turning the amplifier off and on - the tuner will briefly sweep through all the stations and may still lock onto the stronger signal.
Signal strength comparison measurements may be made by connecting a high resistance voltmeter between the earth link (central) and AGC link (rear) at the top of the module. With antenna disconnected, the reading should be in the order of 4.5Volts DC. With the antenna re-connected, and a signal tuned in, this reading will drop by an amount dependent upon signal strength, although not linearly. With AFC disabled as above, this AGC reading will enable a more accurate tuning to any particular station.
Squelch adjustments are facilitated by the small pre-set potentiometer at the bottom of the module. The squelch threshold level may be reduced by turning this control VERY SLIGHTLY anti-clockwise.
Audio output may be adjusted by turning the pre-set potentiometer which is situated towards the top of the module.
Whilst tuner modules behave identically to other modules in the range, the following points should be noted.

a) The XAM.2 tuner is a single station receiver whose frequency is fixed and determined by a crystal. The station chosen in advance by the user (assuming sufficient signal strength exists at the intended location) CANNOT be altered by adjustments. The module may be exchanged however at any time for a nominal charge.

b) Only one XAM.2 module can be used in a GTM.3 or GTMA amplifier, and it must always occupy module position 5.

c) Only one VFM.3 module can be used in a GTM.3 or GTMA amplifier and it must occupy module position 6. The flying lead of this module should connect to the polarised pin set on SWPC.1 switch PCB (the front selector switch).

d) The four VHF stations selectable by the front switch are tuned-in on installation by adjustment of the corresponding pre-sets on SWPC.1. See Fig.1 and APPENDIX D for identification.
Adjust clockwise to increase frequency.

e) Position ‘F’ of the music selector switch is for acceptance of auxiliary music signals from input socket No.4. A suitable module must be inserted in Module position 4 for this purpose.

See also Table 1 on page 5.

Antenna Requirements
A single 75 ohm standard coax socket is provided on the rear panel for acceptance of a composite VHF/MW radio signal. We would recommend a loaded whip antenna for medium wave reception, and a suitable one is manufactured by:

Aerial & Cable Equipment Ltd., 343-345 High Street, Cheltenham, Gloucestershire, England, GL50 3HS
Telephone 01242-511511 Fax 01242-221888

For VHF reception, a multi element array would be appropriate though as these are directional, a compromise between stations required, their relative signal strengths and relative geographic locations must be considered.

PRIORITY INPUT FACILITIES - all units except A.140 & A.280

Priority circuitry is fitted as standard to inputs 1, 2 and 3 any of which, when triggered will override input channel 4. Bridging pins 4 and 5 on the respective input sockets is the means of triggering, which may be by means of a remote microphone switch, or alarm panel relay for example. The current switched is approximately 2mA at 15V DC, and a switching resistance of 500 ohms is acceptable.
The priorities of these 3 inputs may, by means of Molex style jumpers (or PCB links on earlier models) be organised in ladder priority, equal access priority, or a combination of both. The links X, Y, and Z and their functions are shown in Fig. 2 and Table 3. Where equal access is provided, then the other equal access channel(s) will be locked out for the duration of triggering. Upon release of any currently triggered priority input, any other input which has been concurrently attempting to gain access will be enabled.
Simultaneous with the above priority access, two module trigger pins adjacent to each input module are brought into circuit. These are ‘-trig’ and ‘+trig’ (see Fig. 2) and are for use in triggering aspects of certain input modules, e.g. the chime circuitry of a QM.6 module, such that the chime sequence commences only when access is achieved rather than when access is sought.

LINKS MADE	PRIORITIES PROVIDED
Z	1over 2 over 3 over 4
X & Y & Z	(1 = 2 = 3) over 4
Y & Z	(1 = 2) over 3 over 4
X	1 over (2 = 3) over 4

Table 3. Priority link functions

Re-assignment of inputs 2 and 3. Links A and B may be used to change the signal routing of modules 2 and 3 respectively so that they adopt a passive status equal to module 4. This may be useful where two (or three) AUX inputs need to be passively mixed but still to be over-ridden by input 1 (and 2 and/or3). As supplied, links are connected acros positions AB and CD so that

inputs 2 and 3 are in priority mode. Move the links to BC and/or EF to change them to passive mode. They will then be enabled until muted by a priority input. All aspects of priority triggering for inputs 2 and/or 3, and their related current sinks, may then disregarded.

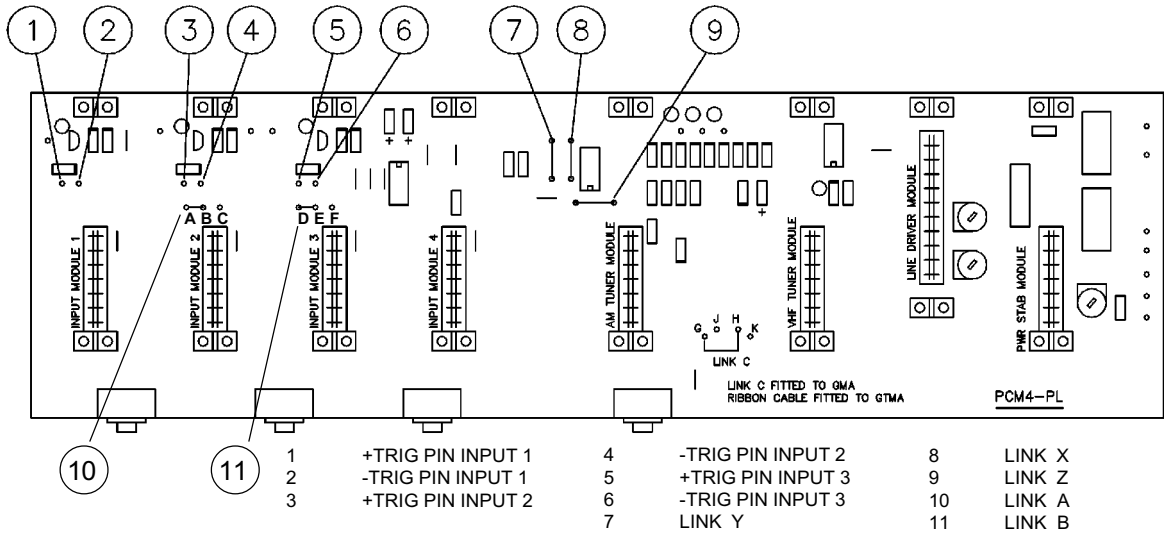


Fig.2 Identification of priority control pins and links.

Tone generator triggering & priority access

If triggering of an alarm tone generator module is required simultaneously with priority operation, pin 5 and the appropriate triggering pin should be linked at the input plug. See APPENDIX B for clarification of these connections.

The front panel volume controls are operated in the normal manner for priority operation. Consequently if an alarm tone module is fitted to a priority channel in an automatic alarm system , it is important that the control is not inadvertently turned to “0”. This is best ensured by the fitting of a spindle lock to the control spindle.

PRE-ANNOUNCEMENT CHIMES - all units except A.280

The customary ding-dong chime signals which can often be heard to precede announcements in public buildings, are generated in the GA range equipment by the actual microphone input modules associated with the respective microphone. It is possible therefore to install two or more such modules, and adjust them so as to be readily distinguishable. See the corresponding sections describing the chime microphone modules for specific information.

MIXER FACILITY CONNECTIONS - 0dB SIGNAL ACCESS POINT

This rear connector provides the means of interconnecting external equipment to the unit at an internationally agreed signal level. Other equipment with input/output signal levels specified as being 0dB will therefore be fully compatible with GA range equipment.

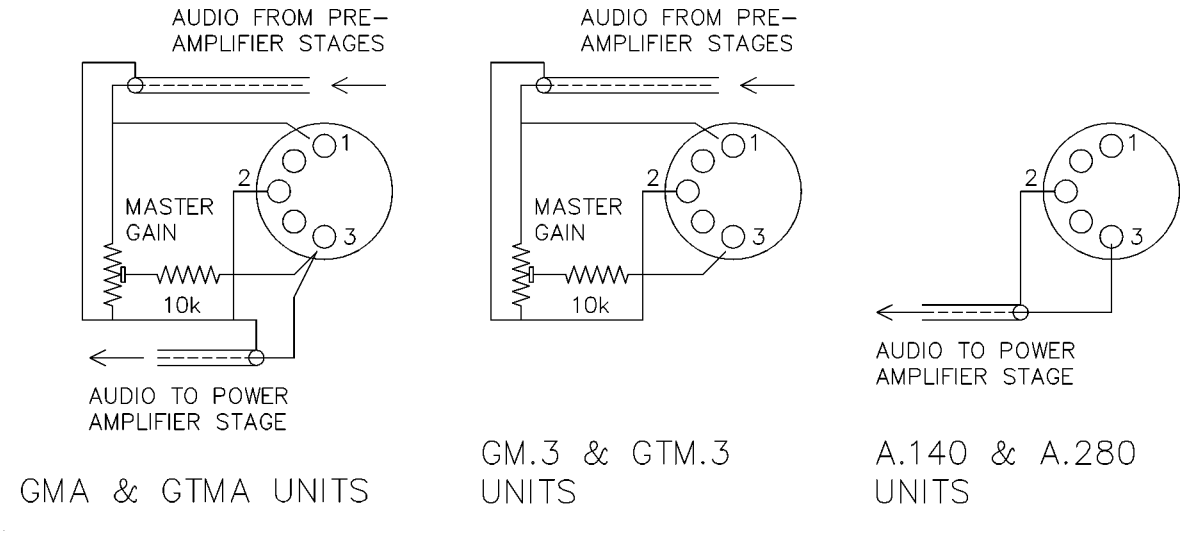


Fig.3 Mixer facility connections for standard locking DIN connector

0dB signal in/out access for mixers & mixer amplifiers -
The standard Locking DIN pin connections are as follows:-

Pin 1 .775V @ 600 ohms from the mixer (pre-master control)
Pin 2 signal earth (cable braiding)
Pin 3 .775V @ 10K ohms via master control (also access to power amplifier input for mixer amplifier units)
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.

Input connections for A.140 & A.280 amplifier
The standard input circuit is suitable for unbalanced line operation, and the locking DIN signal input connections are:-

Pin 1 No connection
Pin 2 signal earth (cable braiding)
Pin 3 .775v @ 10k ohms power amplifier input

Signal arrangements and cable connections are shown in Fig. 3

As a special option, A series slave amplifiers may be fitted with a balanced input transformer, making them suitable for either balanced or unbalanced operation, and rendering them proof against any form of hum loop or signal earthing problem. The input signal circuit has no earth connection, and is referred to as being "fully floating".

The Locking DIN pin connections are:-

Pin 1	No connection	
Pin 2	out of phase audio	.775V RMS @ 10k ohms
Pin 3	in phase audio	balanced (floating)

These amplifiers have a fixed sensitivity and no input control is provided on standard models. The input impedance is approximately 22k ohms.
Immediate technical advice for specific problems is available from the Technical Services Department, Mustang Communications Ltd.

Please also see the section of this manual which covers earthing and earth/hum loops.

Tape recording
The mixer facility socket of mixers and mixer amplifier units 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 non-dependent on master gain control
Pin 2 signal earth (cable braiding)
Pin 3 signal via master control

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

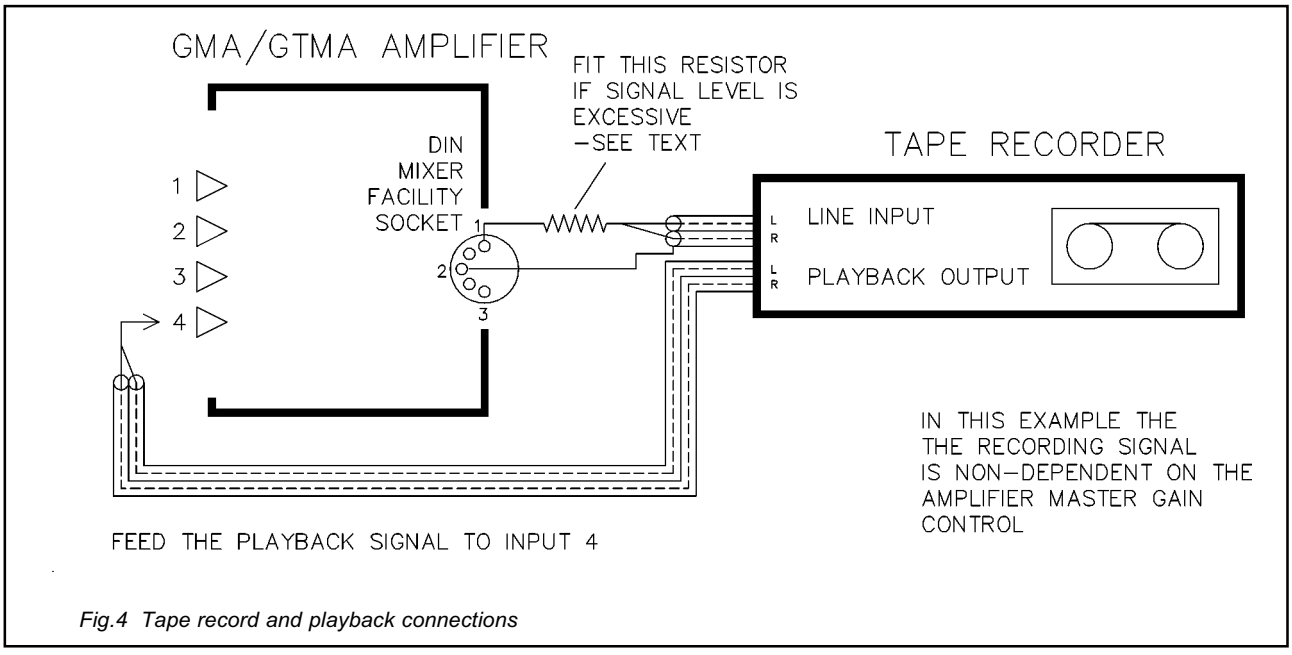


Fig.4 Tape record and playback connections

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. 4
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.

Tape playback
A playback signal would preferably be routed through a standard line input module (T.5, L.5, or L.50 etc) which accommodate a wide variety of signal levels. The module should be located in module position 4. L.5 & L.50 have floating input circuit, and would be most useful where hum loops are likely to be a problem - such as in complex sound installations. See the module details for connection data.

Interconnection of several amplifiers
Larger scale amplification systems may necessitate the interconnection of several amplifiers. The most usual situation would be the attachment of extra slave amplifiers to a mixer amplifier in order to increase the available power output whilst delivering the same program. This is made possible by linking the appropriate mixer facility socket pin (pre or post master gain where available) of the mixer amplifier to the input pin of the slave amplifier(s). The cable should be single conductor screened, and the braid/shield connections should also be made between the appropriate pins. See Fig. 5 for clarification.
NOTE: This is the only means of interconnection that is permitted. It is most inadvisable to attempt to combine the loudspeaker outputs of several amplifiers into one loudspeaker feed line. At the very least, severe problems, and most likely serious damage will result.
The loudspeaker system should always be planned such that it is divided up into sections, each of which will be powered by just one amplifier output section.

POWER AMPLIFIER SECTION

This section of the amplifier circuit consists of a very stable DC coupled driver circuit built in the form of a plug-in module and two or four very substantial output transistors thermally coupled to a substantial heatsink and the rear panel of the chassis. 50 Watt and 100 Watt units use bipolar output devices whilst the 200 Watt units use MOS-FET devices. Adjustments are provided for DC offset voltage and transistor bias, and the module provides comprehensive protection circuitry. The basic circuit has been designed to deliver the full rated power direct into loads of 8ohms for 50 Watt & 100 Watt amplifiers, and 4 ohms for 200 Watt amplifiers, with the output transformer then providing facilities for 100 Volt and 50 Volt line loads. For impedances and loads which cause over-

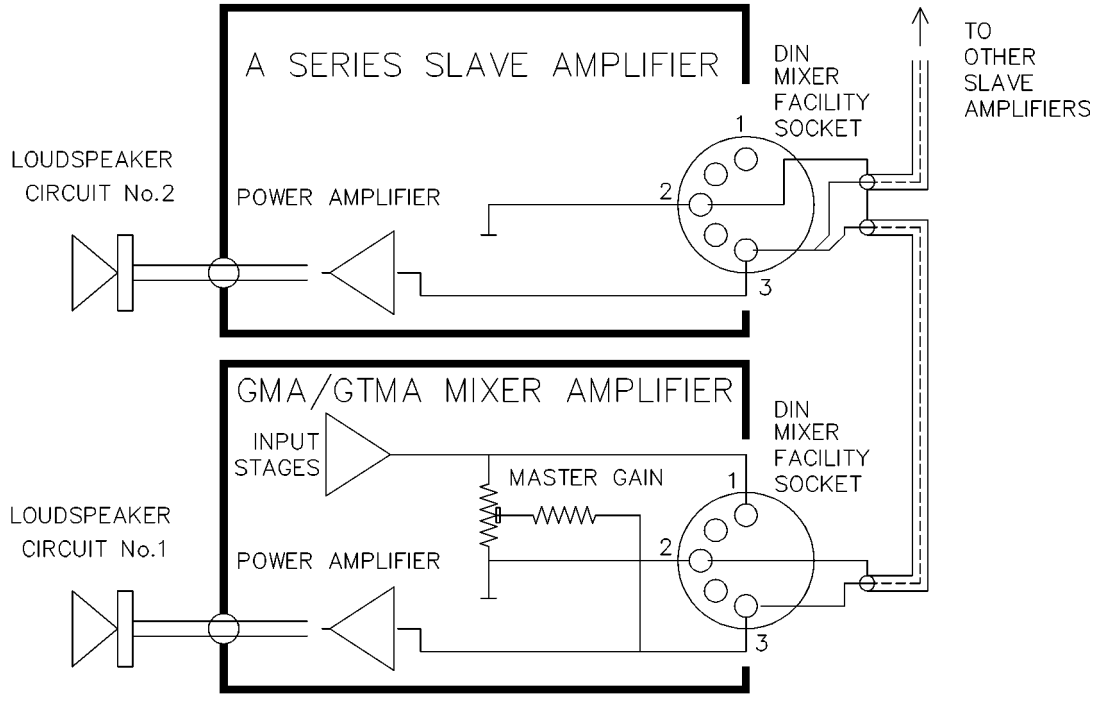


Fig.5 Interconnection of several amplifiers

loading of the amplifier section, the protection circuitry becomes operative progressively. 200 Watt amplifiers also have a temperature sensor bolted to the heatsink assembly which triggers at 100 degrees Centigrade which, via the control board, disconnects the output load, mutes the LED output level indicator and operates the "HOT" indicator. These functions are reset when the heatsink cools down to 85 degrees. Distortion and noise level have been kept at very low levels consistent with wide band width. Unless damage occurs to the driver module or output transistors, the pre-set controls will not normally need adjustment.

LOUDSPEAKER OUTPUT - all units except GM.3 and GTM.3

The amplifier is designed to work primarily with 100V line loudspeaker systems. Facilities are also provided for 50V line and low impedance loads. IT IS ESSENTIAL to provide the correct loudspeaker load for safe and distortion-free reproduction.
The general concept of a 100V line loudspeaker system is that a quantity of 100V line loudspeakers are connected in parallel across the amplifier output terminals. Each loudspeaker features a dedicated transformer which provides 'taps' to enable the installer to determine how much audio power each loudspeaker will consume. The sum total of all the tappings in a system must NEVER EXCEED the rated power of the amplifier. The loudspeakers may be arranged in any order, any combination and if necessary, using any number of feeds from the amplifier. They may be grouped onto sub-circuits which may then be controlled by switching or group volume controls, etc., as required to suit the operational requirements of the system. Sub circuits may be dedicated to 'Page-only' operation (see below).
When designing a line loudspeaker system, bear in mind future adjustments which may be required to individual loudspeakers. These may increase the loading beyond safe limits. Some loudspeakers are also inaccurately rated regarding loadings.
For examples of load arrangement see the section "Typical loudspeaker load arrangements" below.
When connecting a GA mixer amplifier or slave amplifier onto an existing loudspeaker network, the connections to the existing amplifier would be taken only as a guide, and steps should be taken to verify this observation by either:-

a) visually checking the manufacturer's tags on loudspeakers and calculating the resultant load

or preferably

b) measuring the load by a proprietary impedance bridge

The cover provided on the output barrier terminals is a safety cover and should be retained. Access to the terminals is gained by removing the 4BA nut on the left and lifting that end clear of the stud. The cover may now be swung round.

Full program 100V output
The loudspeaker output terminals marked +50++50+ will deliver conventional full program content, i.e. all music and all paging/ priority signals. For 100V line loads connect between the two outer terminals and for 50V line systems connect between the centre and right terminals.

Page-only 100V output
These two terminals provide the program output associated only with the priority input channels (1 to 3). This output is energised only when priority access is gained to any of these channels. This facility may be used for example in an office area of a factory, where only the paging or alarm signals will be required whilst the rest of the factory uses the amplifier full program output for background music with the same paging or alarm signals.
The combined load on these two sets of terminals should be used for all load calculations or measurements. All 5 terminals are floating free of earth. The 100V line outputs may be centred - or balanced around earth by connecting the central +50++50+ terminal to 0E. This may be advantageous in larger installations involving long cable runs adjacent to sensitive microphone lines.

Low impedance output
The two terminals on the left of the block marked "0E" and 4 ohm (or 8 ohm) are for low impedance loads, and provide full program at full rated power. 0E is connected internally to signal earth whilst the other is the direct connection to the amplifier output.

Typical loudspeaker load arrangements
The following are acceptable examples of loudspeaker loading arrangements:

a 400 x 1/2 Watt 100 Volt line speakers = 200 Watts total load to the amplifier. Use a 200 Watt amplifier

b 200 x 1 Watt 100 Volt line speakers = 200 Watts total load to the amplifier. Use a 200 Watt amplifier

c 2 x 50 Watt 100 Volt line speakers = 100 Watts total load to the amplifier: Use either a 100 Watt amplifier (or a 200 Watt amplifier to allow for 100 Watts future development).

d 8 x 5 Watt 100 Volt line speakers = 40 Watts total load to the amplifier, and therefore 10 Watts spare capacity for future expansion if using a 50 Watt amplifier

e 10 x 5 Watt, and 6 x 2 Watt 100 Volt line speakers = 50 + 12 Watts = 62 Watts total load to the amplifier. Use a 100 Watt amplifier.

f 4 x 60 Watt units each tapped at 30 Watts, and 20 x 4 Watt units tapped as follows: 5 @ 4 Watt, 5 @ 2 Watt and 20 @ 0.5 Watt 100 Volt line speakers = 160 Watts total load and therefore 40 Watts spare capacity for future expansion or for final adjustments. Use a 200 Watt amplifier

All the loudspeaker combinations above are wired in parallel across the loudspeaker lines. Several lines may be returned to the amplifier position from various directions and they should all be connected in parallel across the output terminals. It is NOT good practice to incorporate series-parallel loudspeaker loads.
See APPENDIX C for clarification of these connections.

Low impedance and line loudspeakers may be incorporated in the same system. For example, if an 8 ohm load is connected across the 4 ohm terminals of, for example a 200 Watt amplifier, then this low impedance load will draw nominally 100 Watts, thereby enabling a further 100 Watts of 100 Volt line loudspeaker load to be connected across the 100 Volt line output terminals.

AUXILIARY OUTPUT CONNECTIONS- all units except A.140 and A.280

Facilities are available to control the operation of external devices such as switching relays and indicators, whose operation may be associated with the priority operation of the amplifier.

Priority controlled DC current sinks

This unusually comprehensive feature is rarely found on general purpose amplifiers but is useful in microphone paging or alarm systems where a number of operations may be required co-incident with the use of the priority facilities, e.g.

a The introduction of 'page only' 100 Volt loudspeaker circuits by using relays to switch them on only during paging.
b The restoration to full volume of a remote 100 Volt loudspeaker group volume control, such as the Mustang MVC series.
c The powering of lamps at a microphone position, to indicate that the amplifier priority system is already in use (by an alarm tone generator for example)
d The interruption by means of a solenoid/relay of the sound output of another amplification system e.g. Juke box
e The sending of a low-level paging signal by means of a relay, to another remote amplification system
f Control of a designated zone control unit from the Mustang ZC or MC range.

The principle of operation is that when the signal priority circuit of channels 1, 2, or 3 is activated, a corresponding 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.
The terminals marked '1', '2', and '3' are individual sinks controlled by inputs 1, 2, and 3 respectively, whilst the terminal marked 'ANY' is activated whenever ANY of the individual sinks is operated.
The 3current sinks are polarity protected for use in positive (+ve) applications up to 40V. DO NOT ATTEMPT to pass more than 0.5A.
NEVER connect the +24V and current sink connections directly together - serious damage will result. In the off state there is effectively no connection.
See APPENDIX B for typical applications of the Auxiliary Output connections.

24V DC supply

The 24V+ terminal of the Auxiliary output connector provides an unstabilised DC supply, which is limited to 1 amp by an internal fuse on the main printed circuit board and the return is via the 0V terminal. This feature would normally be used with the DC current sink.

COMBINING THE INPUT/OUTPUT FACILITIES OF TWO OR MORE UNITS

This may be considered where one single amplifier cannot provide enough input facilities or output power for a particular application. GM.3 mixers may be combined with GMA or GTMA units, and with A.140 slave amplifiers in any combination via their respective mixer facility sockets.

Example GM.3 and GMA.2803 to provide 5 priority inputs and one non priority input. Fit a T.5 module in input 1 of the GMA.2803 and drive it from the mixer facility output of the GM.3. Connect the 'ANY' sink of the GM.3 to pin 5 of the input No.1 (GMA.2803) such that any priority operation of the GM.3 seeks access to input No.1 (GMA.2803) as though a normal input. All individual sinks on either unit will still be relevant. The mixer facility of GMA.2803 may be used to drive slave amplifiers in the same system if required.

Example GTMA.1403 and A.140 to provide 200watt output to two loudspeaker zones. Interconnect using pins 3 of each mixer facility socket.

Example GMA.2803 and two A.280 to provide 600watt output to a single loudspeaker line (100V only). Interconnect using pins 3 of each mixer facility socket. Page-only capability will still be available - up to the 200 Watt power capability of the GMA.2803.

NOTE
The loudspeaker system should always be planned such that it is divided up into sections, each of which will be powered by just one amplifier output section.
It is most inadvisable to attempt to combine the loudspeaker outputs of several amplifiers into one loudspeaker feed line. At the very least, severe problems, and most likely serious damage will result. Whilst it is technically feasible, the risks faced will render it an impractical option. For clarification, consult the System design department of Mustang Communications Ltd.

OUTPUT DISCONNECT CIRCUIT - 200 Watt units only

This circuit provides three functions

a. to connect the loudspeaker load by means of an internal heavy duty relay approximately 2.5 seconds after the mains switch has been operated, to enable all capacitors and circuitry to stabilise - thereby providing a silent "switch on". This delay also enables external mixers and associated equipment to stabilise.

b. to disconnect immediately in the event of:

1. one or both DC fuses failing
2. AC fuse failing
3. output transistors overheating
4. output transistor short circuit

This disconnect circuit also mutes the LED ladder display during disconnection, to avoid paralleled amplifiers giving a misleading indication. The output disconnect circuit provides vital protection of the loudspeaker load. No user controls are provided.

THERMAL CUT OUT - 200 Watt units only

This unit is fitted to the inside rear panel behind the black heatsinks and senses the temperature of the output transistors. Should they exceed 100 degrees centigrade, the cut out will be operated, triggering the output disconnect circuit and "HOT" flashing LED. The disconnection of the load (unless there is a fault) will enable the amplifier to cool to 85 degrees centigrade at which point normal operation will be resumed.

This is a vital device for protection of loudspeakers and amplifier and should UNDER NO CIRCUMSTANCES be interfered with.

AC MAINS POWER INPUT

The power requirement for the amplifier, even when used at full power, is minimal and should be taken from the AC mains supply via a 3 core flexible cable. It is vital that the connections to the mains input line socket are made to the correct terminals and that a suitable earth connection is available. The connections are:-

L Live
N Neutral
E Earth

DO NOT operate the amplifier under any circumstances without an electrical earth connected. This is a permanent safety earth.

EARTHING/HUM LOOPS

A hum loop is most likely to be the cause of a distinct and sharp hum or buzz in the loudspeakers at constant volume, EVEN WITH ALL THE INPUT CHANNEL VOLUME CONTROLS TURNED FULLY OFF, but with the input cables connected at the rear. Alternatively it may be due to a short circuit inside the input plug, between the cable braid and the cable clamp or plug body. Confirmation of a loop can be made by removing all the signal input plugs, and the mixer facility plug, with a monitor loudspeaker connected, and the amplifier switched on. At some point, the hum should disappear, only to return when the offending input plug is replaced. See also the Fault diagnostics section, - "7-8 - parasitic oscillation".

The input socket signal earth connections are internally earthed (unless a balanced/floating circuit is in use) via the input modules to the mains earth via the chassis. If ancillary equipment e.g. tuners/tape players/record players etc., are to be connected to the unit, steps must be taken to ensure that the signal cable braiding is not already earthed before reaching the units, otherwise a hum loop will be formed. Use an ohm-meter or equivalent to check this. It should be possible in high quality equipment to disconnect the ancillary equipment earth from its chassis connection thereby breaking the loop. Some ancillary equipment is not normally connected to the mains earth via its mains lead, relying on "double insulation", and in such cases, the signal earth is automatically free of mains earth.

Should it be found necessary to disconnect the signal earth from the chassis of the GA amplifier, a green wire link can be found adjacent to the mixer facility socket inside the chassis, or alternatively connected to a solder-tag in the corner of the rear panel/side panel close to the mains transformer. Snip this link and bend it back. The whole of the GA circuitry should now be free of earth. In exceptional circumstances the normal mains earth connection of ancillary equipment may be disregarded to break a hum loop only if the equipment is to be permanently connected to the VA amplifier thereby relying on its earth connections, and only if no other possibilities exist.
We do not consider this step to be advisable in view of the safety risk.

A hum loops on mixers/mixer amplifier units may also be broken by the use of an L.5 or L.50 input module for certain applications. These modules operate with input circuitry fully floating free of earth. Similarly, a.140 and A.280 amplifiers may be ordered with a specially fitted floating balanced line input transformer.

DO NOT OPERATE THE AMPLIFIER UNDER ANY CIRCUMSTANCES WITHOUT AN ELECTRICAL EARTH CONNECTED VIA THE MAINS CONNECTION.

FACTORY FITTED OPTIONS

Automatic level control - all units except A.140 & A.280
Mustang product codes ALC-4

Where this option is taken up, the standard complement of TB4 tone control module is replaced by sandwich-style modules type TB4-ALC, comprising a normal TB4 combined with an ALC.2 automatic level PCB.

It will have been specified where -

a) The amplifier output is required to be limited to prevent clipping distortion;
b) Circumstances where 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.

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.
Pre-settable adjustments are provided for:

a) LEVEL i.e. the threshold level at which peaks are detected and which therefore determines the maximum output level.
b) GAIN i.e. the overall gain of the module.

Viewed from the print side, clockwise adjustment of the LEVEL control increases the output maximum level from -24dBM to +8dBM. Similarly, clockwise adjustment of the GAIN control increases the gain from 0dB to +24dB approximately. As supplied by the factory, GAIN is set to 0dB (unity) and the LEVEL control is set to maximum, and therefore no effect will initially be apparent.
In practical terms, the module may be set-up as follows:
With excess input signal, and the master gain set to 10 (maximum) the setting of the LEVEL control is adjusted to limit the output of the unit to the required level. Then the GAIN may be adjusted such that with normal settings of the amplifier input gain controls, the lowest level of input signal will drive the amplifier to reach the setting of the LEVEL control. In this condition, a relatively uniform output level will be achieved - even with low level input signals.
To minimise unwanted processing noise, and to reduce the possibility of distortion being introduced, it is always preferable to set the master gain to maximum and to rotate the input gain controls to a normal setting before adjusting the TB4-ALC settings.

Spindle locked controls
Mustang product code SP.LK

Spindle locks, if fitted, are intended to prevent unauthorised adjustments being made. To enable adjustment, carefully slacken the front nut using an appropriate spanner and turn the control shaft using a screwdriver blade, to the required setting.

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 amplifier, 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.

Selection of loudspeaker cables
Use of an appropriate cable for the connection of loudspeakers to the amplifier will ensure that a minimum amount of audio power is lost during transmission to the loudspeaker network. The loss will depend upon several factors - loudspeaker loadings, size of cable conductor, length of cable, etc.
As a general rule, for any particular loudspeaker system, the longer and the thinner the cable, the greater will be the loss. We therefore recommend, that the system is planned such that the amplifier is as near as possible to the loudspeakers, especially with low impedance loudspeakers, and that the cable used is as large as practicable.
Whilst it is not possible to be specific about the precise cable to be used in any particular system, we would suggest as follows:

a) for 100V line systems, with loudspeakers located up to 50 Mtrs, twin conductors of 1.0 sq.mm cross-sectional area. (0.5 sq.mm for 50 Watt units)

b) for 50V line systems with loudspeakers located up to 50 Mtrs, twin conductors of 1.5 sq.mm cross-sectional area. (1.0sq. mm for 50 Watt units)

Either solid or flexible conductor cables may be used, or a combination of both. It would be appropriate for a heavy duty cable to be used between the amplifier location and the general loudspeaker location - carrying the full load, and for the subsequent loudspeakers of the network to be interconnected with thinner cable.

Siting

The position chosen for installation of the amplifier will depend upon many individual factors outside the scope of this manual. However, when low impedance loudspeakers are to be used the amplifier should be positioned as close as possible to them. Similarly, high impedance microphone leads should be as short as possible. Please also refer to the following paragraph on ventilation. Choose a position where there is little likelihood of any liquid being spilled on the amplifier.

Ventilation

Individual mixers and amplifiers in the GA range develop very little heat when switched on and not in use. GM.3 and GTM.3 develop virtually no heat in use and need minimal ventilation. Mixer amplifiers and slave amplifiers develop moderate amounts of heat dependent upon the amount of sound power delivered to the loudspeaker loads. The design of these amplifiers is such that heat is conducted from the rear panel across the whole of the chassis which is in effect a very large heatsink and designed to dissipate the heat by convection. However, in order to do this the amplifiers needs ventilation space at least at the rear and sides. Rack mounting amplifiers in irregular or spasmodic use may be stacked as required provided that there is sufficient free flowing air at the rear.

If several 200 Watt amplifiers, are mounted in a rack, and used in a demanding application e.g. alarm tone generation, continuous full power music, etc., then it is likely that the heatsink temperature will exceed 100 degrees centigrade at which point the thermal cut out will operate and the amplifier will shut down to enable it to cool. This can be inconvenient (or dangerous in an alarm generation system) and consideration should be given to spacing the amplifiers. A 1U space should be provided between every second amplifier, and for systems over 400 Watts, forced ventilation should be used too. Mustang FP.2S or FP.2B fan panels and corresponding ventilation panels may be specified.

The amplifiers' naturally long operational life may be realised by a cool operating environment.

To summarise, if GA amplifiers are to be used at high power levels DO NOT:-

a) install in small enclosed cupboards
b) stack in rack cabinets without adequate cooling, spacing, or ventilation
c) install above radiators or near heaters
d) block-in side and/or bottom surfaces

Interference

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 equipment.

Checklist

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

Use of priority for input channels
Priority control out to remote relays, lamps, etc.
Individual input module sensitivity adjustment
Bass cut on microphone input module
Pre-announcement chime level - or off
ALC auto level control adjustment
Spindle locks tightened

FUSES

If a fuse blows repeatedly, a fault is indicated. Do not attempt to force the amplifier by fitting larger fuses. All fuses should be replaced as a matter of routine every year if in regular use. The two printed circuit fuses to be found on pre-amplifier main boards will not normally need to be changed unless a fault occurs. When replacing fuses, disconnect the mains supply and allow a few minutes for capacitors to discharge. The fuses, their functions, values and locations are shown in APPENDIX D.

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 and loudspeakers are properly connected and in good working order. Be sure to check these carefully first before investigating the amplifier.

FAULT SYMPTOM	**CHECKLIST**
1. Sound off, mains power switch lamp off	Mains fuse, mains lead, mains power, mains switch.
2. Sound off, mains power switch lamp on	DC fuses, HT voltages, output transistors, input connections module edge connectors, output transformer continuity, IC-1, IC-2, IC-3, mixer power supply module, mixer tone control module, mixer AC supply fuse, priority channel not being triggered, (channel 1/2/3 only), non-priority channel (No.4) being muted by operation of channel 1/2/3
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, incorrect loudspeaker load, 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, incorrect loudspeaker load, partial loudspeaker line short, output transformer short circuit, master control set too low.
7. Case gets very hot	Incorrect (excess) loudspeaker loadings, see page 20, parasitic oscillation (usually accompanied by soft hum and mild distortion and appears and disappears at a certain treble control setting) see 8 below, insufficient ventilation, see page 24
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, IC-1, IC-2.
9. Soft hum - volume controls down	Earth/hum loop - see page 22, 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 GA amplifier or ancillary equipment, earth/hum loop, see page 22.
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 22.
13. Loud harsh hum	Disconnected signal input braiding, or buzz earth/hum loop, see page 22
14. Intermittent loud cracking	Strained input module edge connectors, dirty edge connectors, intermittent input lead connections, dirty voltage selector pins, dirty mains plug pins, loose mains fuse, radiated interference from thermostat etc. see also No.5 above.
15. Howling or ringing and booming	Acoustic feedback between microphone and loudspeakers.
16. DC fuses blowing	Failed output transistors and/or driver board or excess loudspeaker load.
17. Mains line fuse	Mains switch suppressor shorted, main rectifier failed, mains transformer failed.
18. Channel No.1 and/or No.2 and/or No.3 off	Incorrect priority triggering, IC-1, IC-2, IC-3, module edge connector.
19. Incorrect signal priority	IC-1 and/or IC-2 and/or IC-3, incorrect link setting on installation
20. Channel No.4 (only) off	Module edge connector, IC-1, IC-2, IC-3, music selector switch PCB if fitted, inadvertent triggering of channel 1/2/3.
21. Intermittent sound	Strained input module or driver board edge connector, fractured input cable, worn volume control track.
22. Mixer AC supply fuse blowing	Mixer power supply module.

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 GA range of amplification 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 board. It is unlikely that the main board will ever need to be removed except for the removal of spilled liquid, or broken mechanical parts. The following information is a procedural guide for the most likely problems.

Free standing case removal

Free standing cased amplifiers are dispatched with the case fitted and to make any internal adjustments or module changes it will be necessary to remove it. Turn the amplifier upside-down on a clean soft surface to avoid scratching and remove the four outer cross-point headed screws. Revert the amplifier and using strong finger pressure, push out the bottom flanges at both sides of the case, and slide it upwards over the chassis. Replacement is a reversal of this process. Line up the holes in case and chassis before attempting to re-fit the screws. Use the correct size of screwdriver.
The case is manufactured from PVC clad aluminium and therefore, whilst being washable it will not withstand any direct heat, i.e. cigarettes, soldering irons etc.

Removal of main pre-amplification circuit board

Remove the gain control knobs and control nuts. Remove all the modules. Remove four 6BA nuts spaced along the board. By lifting the rear edge of the board it will now be possible by using pressure on the control spindles to push to board backwards and upwards giving access to the bottom of this circuit board. De-solder the signal cableform if complete access is required.

Output transistor replacement

In the unlikely event of failure, it is important to replace these components with original specification parts, in matched pairs. Gently prise off the glued plastic shrouds covering each output transistor and remove the screws and mica washers with each device. Great care should be exercised when handling output devices from the 200watt amplifiers as these are of the MOS-FET type and susceptible to damage by static charge build up on the gate. When replacing MOS-FET devices, always check the 1K ohm gate resistors adjacent to the device sockets are intact before refitting devices. If these have failed too, then components on the driver PCB may also be damaged. When replacing 50W and 100W output devices all driver PCB semiconductors should be checked. Always replace all the main DC fuses when repairing a power output stage failure.
Locations are shown in APPENDIX B.

Integrated circuit replacement

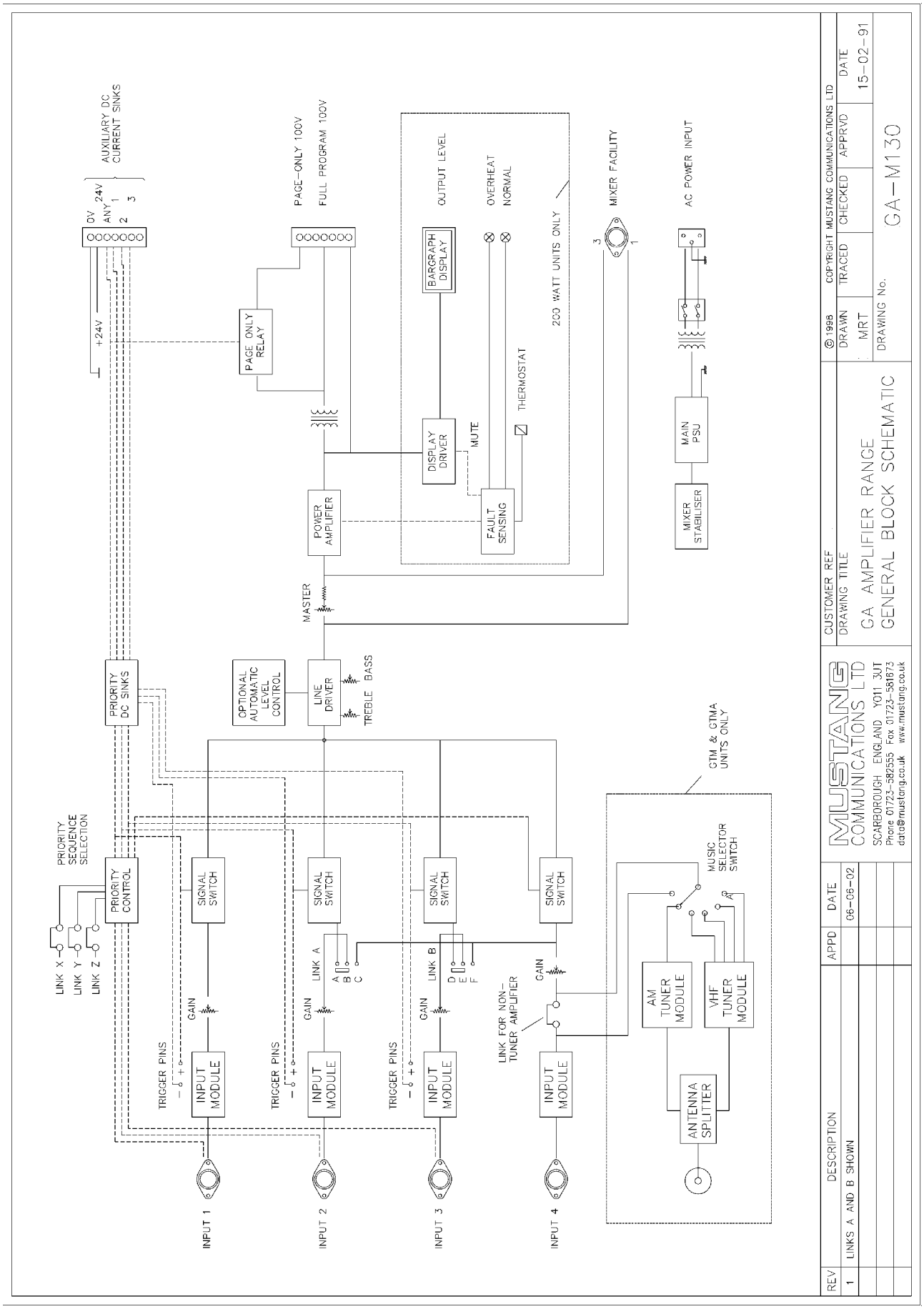
These are push-fit in sockets on the main board. Replacement is simply a matter of pulling out the suspect IC and pushing in a new one taking care not to force or bend the pins. Take care to observe which way round the IC is fitted - a small notch or indent in one end is the indicator, and is shown on APPENDIX D.

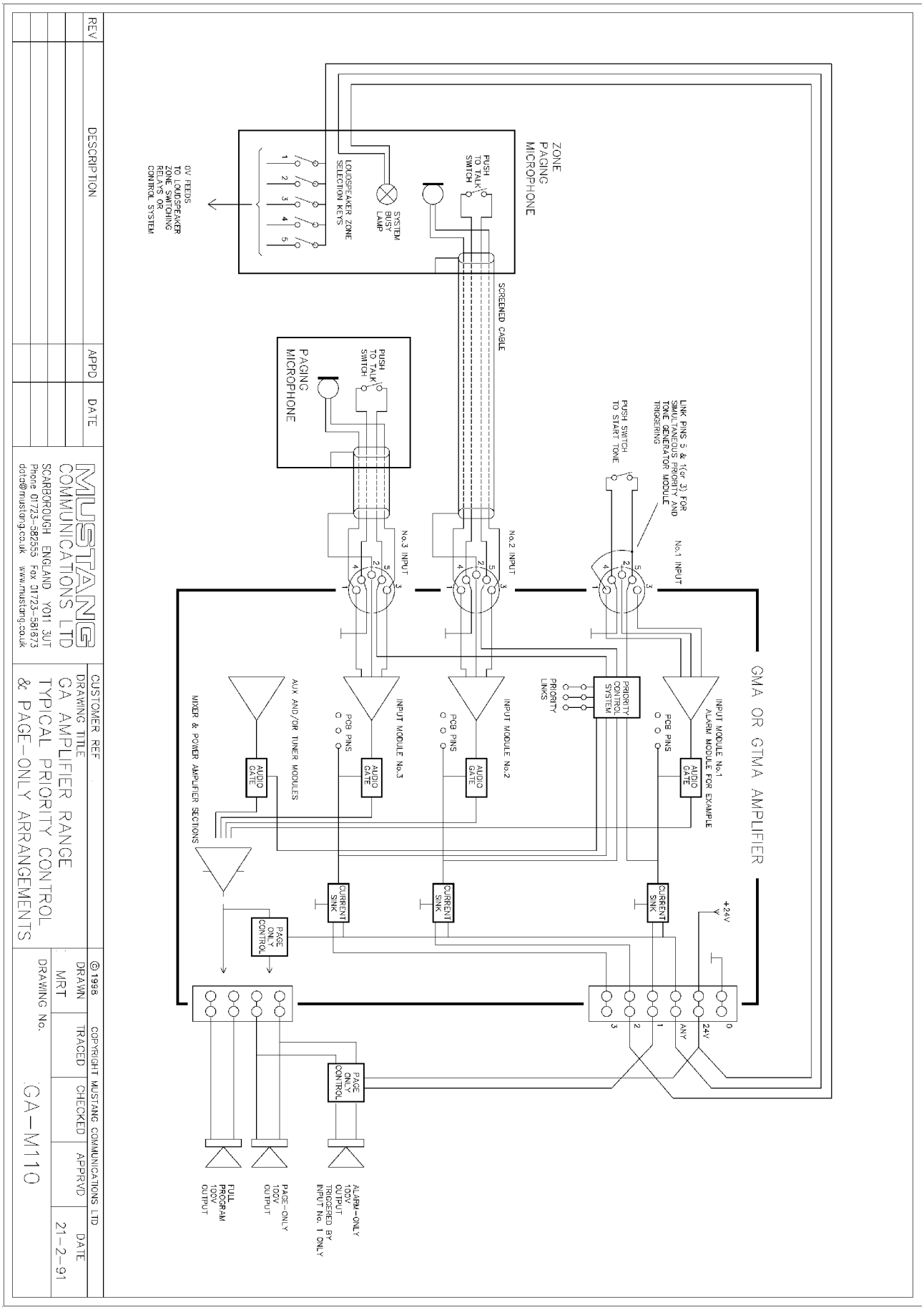
WARRANTY

This amplifier should operate successfully for many years if installed correctly. However, should any fault occur within 24 months of installation, irrespective of usage or application, 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.


AUXILIARY DC CURRENT SINKS
0V
24V
ANY
1
2
3
+24V
PAGE-ONLY 100V
FULL PROGRAM 100V
PAGE ONLY RELAY
OUTPUT LEVEL
BARGRAPH DISPLAY
OVERHEAT
NORMAL
200 WATT UNITS ONLY
MIXER FACILITY
AC POWER INPUT
DISPLAY DRIVER
MUTE
THERMOSTAT
FAULT SENSING
POWER AMPLIFIER
MAIN PSU
MIXER STABILISER
MASTER
PRIORITY DC SINKS
OPTIONAL AUTOMATIC LEVEL CONTROL
LINE DRIVER
TREBLE
BASS
PRIORITY SEQUENCE SELECTION
LINK X
LINK Y
LINK Z
PRIORITY CONTROL
SIGNAL SWITCH
GAIN
LINK A
LINK B
A
B
C
D
E
F
TRIGGER PINS
INPUT MODULE
LINK FOR NON-TUNER AMPLIFIER
GTM & GTMA UNITS ONLY
MUSIC SELECTOR SWITCH
AM TUNER MODULE
VHF TUNER MODULE
ANTENNA SPLITTER
INPUT 1
INPUT 2
INPUT 3
INPUT 4
REV
DESCRIPTION
APPD
DATE
1
LINKS A AND B SHOWN
06-06-02
MUSTANG COMMUNICATIONS LTD
SCARBOROUGH ENGLAND YO11 3UT
Phone 01723-582555 Fax 01723-581873
data@mustang.co.uk www.mustang.co.uk
CUSTOMER REF
DRAWING TITLE
GA AMPLIFIER RANGE
GENERAL BLOCK SCHEMATIC
© 1998 COPYRIGHT MUSTANG COMMUNICATIONS LTD
DRAWN
TRACED
CHECKED
APPRVD
DATE
MRT
15-02-91
DRAWING No.
GA-M130



REV	DESCRIPTION	APPD	DATE

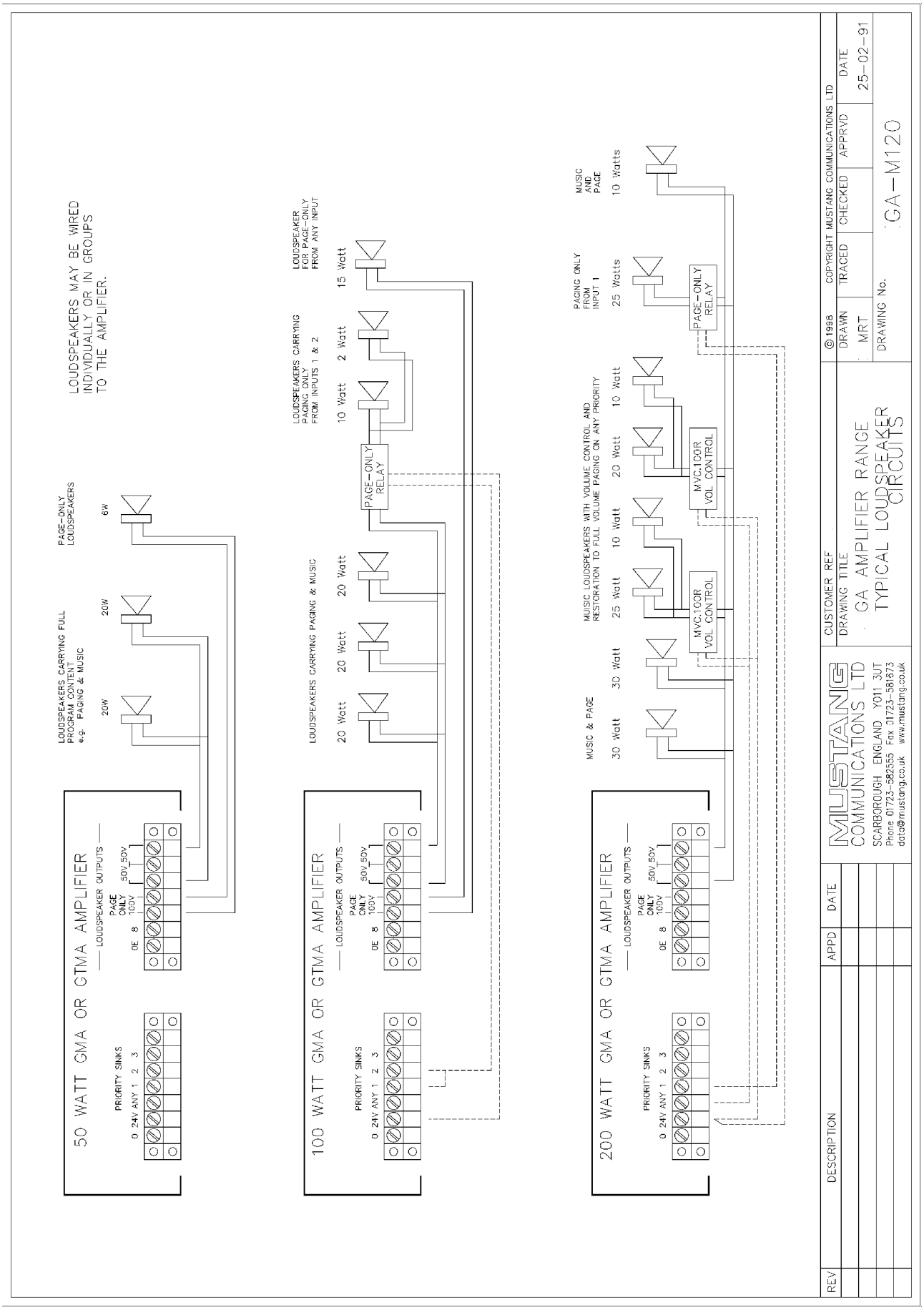
MUSTANG COMMUNICATIONS LTD
SCARBOROUGH ENGLAND YO11 3UT
Phone 01723-582353 Fax 01723-581673
dstaff@mustang.co.uk www.mustang.co.uk

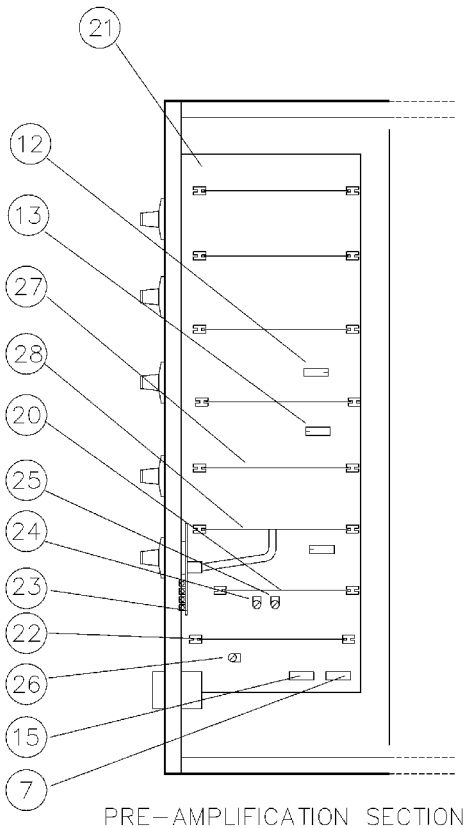
CUSTOMER REF

DRAWING TITLE
GA AMPLIFIER RANGE
TYPICAL PRIORITY CONTROL
& PAGE-ONLY ARRANGEMENTS

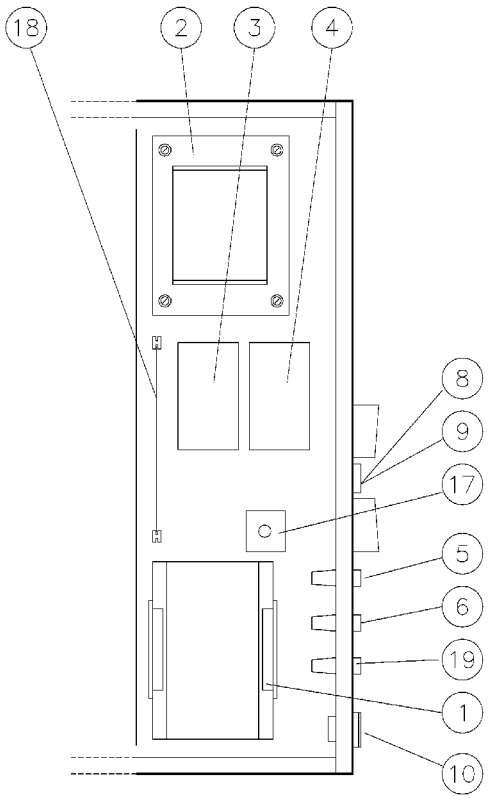
DRAWING No. GA-M110

©1998	COPYRIGHT MUSTANG COMMUNICATIONS LTD
DRAWN	MRT
TRACED	
CHECKED	
APPRVD	
DATE	21-2-91

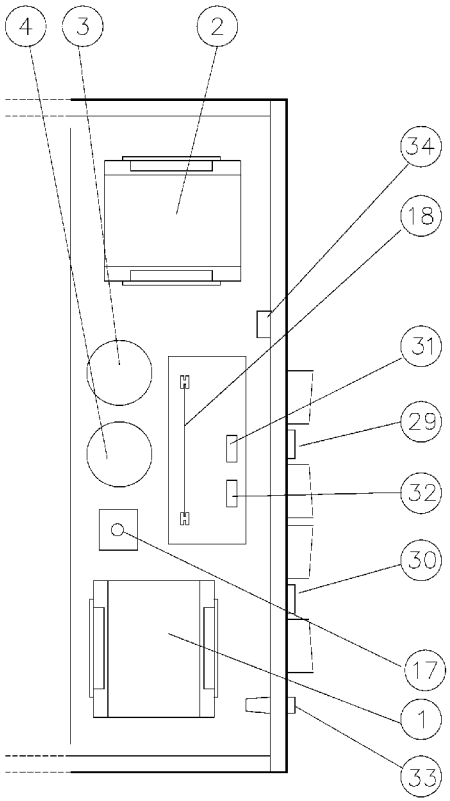

50 WATT GMA OR GTMA AMPLIFIER
100 WATT GMA OR GTMA AMPLIFIER
200 WATT GMA OR GTMA AMPLIFIER
LOUDSPEAKER OUTPUTS
PRIORITY SINKS
0 24V ANY 1 2 3
PAGE ONLY 100V
50V 50V
8E
LOUDSPEAKERS CARRYING FULL PROGRAM CONTENT e.g. PAGING & MUSIC
20W
20W
PAGE-ONLY LOUDSPEAKERS
6W
LOUDSPEAKERS MAY BE WIRED INDIVIDUALLY OR IN GROUPS TO THE AMPLIFIER.
LOUDSPEAKERS CARRYING PAGING & MUSIC
20 Watt
20 Watt
20 Watt
LOUDSPEAKERS CARRYING PAGING ONLY FROM INPUTS 1 & 2
10 Watt
2 Watt
15 Watt
LOUDSPEAKER FOR PAGE-ONLY FROM ANY INPUT
PAGE-ONLY RELAY
MUSIC & PAGE
30 Watt
30 Watt
MUSIC LOUDSPEAKERS WITH VOLUME CONTROL AND RESTORATION TO FULL VOLUME PAGING ON ANY PRIORITY
25 Watt
10 Watt
20 Watt
10 Watt
MVC.1GOR VOL CONTROL
MVC.1GOR VOL CONTROL
PAGING ONLY FROM INPUT 1
25 Watts
MUSIC AND PAGE
10 Watts
PAGE-ONLY RELAY
REV
DESCRIPTION
APPD
DATE
MUSTANG COMMUNICATIONS LTD
SCARBOROUGH ENGLAND YO11 3UT
Phone 01723-582555 Fax 01723-581873
data@mustang.co.uk www.mustang.co.uk
CUSTOMER REF
DRAWING TITLE
GA AMPLIFIER RANGE
TYPICAL LOUDSPEAKER CIRCUITS
© 1998 COPYRIGHT MUSTANG COMMUNICATIONS LTD
DRAWN MRT
TRACED
CHECKED
APPRVD
DATE 25-02-91
DRAWING No. GA-M120



PRE–AMPLIFICATION SECTION



50 & 100 WATT POWER AMPLIFIER



200 WATT POWER AMPLIFIER

1 MAINS TRANSFORMER
2 OUTPUT TRANSFORMER
3 DC+ FILTER CAPACITOR
4 DC– FILTER CAPACITOR
5 DC+ FUSE (3.15A FAST)
6 DC– FUSE (3.15A FAST)
7 AUXILIARY DC FUSE (1A FAST)
8 (TOP) + OUTPUT TRANSISTOR
9 (BOTTOM) – OUTPUT TRANSISTOR
10 MAINS VOLTAGE SELECTOR
11 AUX DC SINK TRANSISTOR
12 AUDIO SWITCHING IC
13 PRIORITY CONTROL IC
15 MIXER AC SUPPLY FUSE (1A SLOW)
17 POWER SUPPLY RECTIFIER
18 POWER AMPLIFIER DRIVER MODULE
19 AC MAINS POWER FUSE (2A SLOW)
20 MIXER TONE CONTROL (LINE DRIVER) MODULE
21 MIXER/PRE–AMPLIFIER MOTHER PCB
22 MIXER/PRE–AMPLIFIER PSU MODULE
23 VHF STATION SELECTOR PCB
24 TREBLE ADJUST
25 BASS ADJUST
26 MASTER ADJUST
27 AM MODULE (GTM & GTMA UNITS ONLY)
28 VHF MODULE (GTM & GTMA UNITS ONLY)
29 – OUTPUT TRANSISTORS
30 + OUTPUT TRANSISTORS
31 DC –FUSE (6.3A FAST)
32 DC +FUSE (6.3A FAST)
33 AC MAINS POWER FUSE (3.15A SLOW)
34 ANTENNA SIGNAL SPLITTER PCB

REV	DESCRIPTION	APPD	DATE

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
GA AMPLIFIER RANGE
MAIN COMPONENT
IDENTIFICATION

DRAWN	TRACED	CHECKED	APPRVD	DATE
MRT				21–02–91

DRAWING No. GA–M100