MUSTANG
COMMUNICATIONS

MMA AMPLIFICATION RANGE

INSTALLATION & MAINTENANCE HANDBOOK

Issue No.7

SCOPE OF THIS ISSUE:

MM.4, MM.6
MM.704, MMA.706
MMA.1404, MMA.1406
A.70, A.140
Input modules
Standard options

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APPENDICES

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 MMA range of amplification consists of high quality general purpose 4 and 6 input mixers, mixer amplifiers and 50 and 100 Watt slave amplifiers. Input pre-amplification, broadcast radio reception and/or the generation of alarm tones takes place on a series of plug-in circuit modules selected from the range indicated on page 6. Treble and bass tone control and power supply regulation is also contained on plug-in modules. After pre-amplification, the resulting signals are directed to mixing and priority switching circuitry. The resultant signals are further amplified by tone control circuits providing variable treble and bass cut and boost before being channelled to the main power amplifier section where fitted. At this stage the signal is finally amplified to a level of either 50 or 100 Watts depending on the model, and the output is available at low impedance, or 50 or 100 Volt line output via the standard fitted transformer. The supply requirements for the amplifier are taken from the normal AC mains supply which is converted to the required DC voltages by a substantial internal power supply. Both AC and DC fuses are available at the back panel.

The controls are simple and convenient to use, comprising one gain control for each input, one or two pairs of treble and bass tone controls depending on the model, and an overall master level control. Slave amplifiers are not fitted with controls. Each unit in the range is also fitted with a mains power switch, and the supply lead is detachable. Input and output connections at the rear are clearly marked. All the units in the range are available either as rack mounting versions or free-standing cased versions. The latter are fitted with plastic feet on the bottom and the cases are easily removable for initial setting up and maintenance.

In use the amplifiers will give trouble free and accurate performance, and any 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 MMA range of equipment will perform with outstanding results in a multitude of applications, and a few only are listed under:-

small stage productions	*tape mixing/recording*
general paging systems	*cine film sound-track systems*
public address systems	*slave amplification*
sound re-inforcement systems	*selective factory paging*
small club systems	*fire and security alarms*
background music	*waiting room call systems*
controlled noise systems	*intercom systems*
audio visual systems	*cabaret systems*
inductive loop systems	*church amplification*

GENERAL SPECIFICATIONS

MIXER AMPLIFIERS	MMA.704	MMA.1404	MMA.706	MMA.1406
Input channels	4	4	6	6
Input level & response	dependent upon input modules fitted			
Treble & Bass adjustment	+/- 12dB @ 100Hz & 10kHz ref.1kHz			
Power output (Watts RMS contin)	50	100	50	100
Current sink	500mA maximum. 1Amp fuse.			
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, 8 ohms -3dB @ 20Hz & 18kHz ref. 1kHz, 100V			
Loudspeaker matching	4-8-16 ohms unbalanced, 100V bal.			
AC mains input	115-220-230-240V 50-60Hz +5% -15%			

POWER AMPLIFIERS	A.70	A.140
Power output (Watts RMS contin)	50	100
Audio input level	775mV, 0dBV @ 22k ohms	
Power amplifier power freq. resp.	-3dB @ 20Hz & 20kHz ref. 1kHz, 8 ohms -3dB @ 20Hz & 18kHz ref. 1kHz, 100V	
Loudspeaker matching	4-8-16 ohms unbalanced, 100V bal.	
AC mains input	115-220-230-240V 50-60Hz +5% -15%	

MIXER	MM.4	MM.6
Input channels	4	6
Input level & response	dependent upon input modules fitted	
Treble & Bass adjustment	+/- 12dB @ 100Hz & 10kHz ref.1kHz	
Current sink	500mA maximum. 1Amp fuse.	
Auxiliary DC	nominally +24V	
Audio output level	775mV nominal. 0dBV	
AC mains input	115-220-230-240V 50-60Hz +5% -15%	

FRONT PANEL CONTROLS AND INDICATORS

The front panel controls have been selected, positioned, and colour coded so that they may be easily understood by non-technical operators. Each input channel is fitted with a volume (gain) control which enables the operator to select suitable signal levels to be passed to the amplifier signal mixing stage. The resultant combined signal is controlled by a master volume (gain) control effecting all channels. Additionally the 4 input mixers and amplifiers are fitted with a bass cut/lift control and a treble cut/lift control which operate collectively on all channels. The 6 input mixers and amplifiers have two sets of treble and bass controls, the first set operating collectively on channels 1 to 5, whilst channel 6 is fitted with its own exclusive treble and bass controls.

The numbers on the knob skirts are entirely arbitrary and enable easy re-setting. In operation the input volume controls will be rotated until the appropriate amount of sound is delivered to the loudspeaker system for each of the input channels in use, whilst the master control may be set at maximum (10). With some input signal sources and module combinations it may be necessary to turn the controls well up though this does not necessarily mean that the amplifier ratings will be exceeded. Conversely if it is necessary to use the controls at very low settings, then it is permissible to reduce the setting of the master control to a more suitable level after having first checked that the input modules have been correctly selected for the application, and adjusted. To reduce the possibility of unnecessary distortion it is always preferable to select the lowest sensitivity modules appropriate for the application, and/or to adjust them for a low rather than high sensitivity position if a control is fitted to the module in question.
Generally speaking the master level control would be operated between position 7 and 10 for normal operation. If the master control is set at a low level then it may be possible to develop enough signal in the first stages of amplification to cause distortion in mid stages and tone control sections on peaks of sound. The resultant distorted sound from these mid stages would be passed on via the master gain control to the power amplifier section and loudspeakers. If fewer than the full complement of input modules is employed, the setting of the spare controls will not effect the performance of the unit.

The bass and treble controls are of the cut and lift type, and the neutral positions will occur at settings 4 to 5. Clockwise rotation will increase the amplifier response at low and high frequencies respectively, and anti-clockwise will reduce it. These controls should be adjusted for personal preference though they would not normally be used outside the range 2 to 8.

The mains power ON/OFF switch is of the rocker type and is operated by inward pressure at the top or bottom of the red front moulding. With mains power connected and the amplifier switched on, the switch will be internally illuminated. The amplifier will function within approximately one second, and when switching off it may continue to function for several seconds whilst the internal power supply discharges and at this point may cause a slight soft 'plop' to be heard through the loudspeakers.

INPUT MODULE SYSTEM - MM & MMA amplifiers

The input module system designed for use with Mustang MMA, GA, 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 MMA range, this will be position 1.
The MMA, GA, 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 21

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.4	Tuner, VHF. (For use with all except GA range amplifiers)
	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	(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. 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)	Balanced input
Pin 2	0V return (cable braid)	
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

Obsolete module 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	300mV - 3.5V input	free of
Pin 3		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)

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. If the module cannot be used in the dedicated input module position, and where signal strength permits, the coax may be connected to the corresponding locking DIN socket as follows -

Pin 1 Inner
Pin 2 braid
Pin 3 N/C

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.

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.4 VHF/FM Single selectable station tuner

These modules consists 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.
The module feature an on-board helical potentiometer for accurate selection of a single station.
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.
The module may be used in any module position. A 75ohm coaxial downlead from the antenna system should be connected to the locking DIN input plug as follows -

Pin 1 inner
Pin 2 braid
Pin 3 N/C

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.

To tune into a station, adjust the helical pre-set resistor (accessible at top rear) clockwise to increase frequency up to 108MHz or anti-clockwise to lower frequency to 88MHz until the required station is located.

It is normally necessary to tune to the centre frequency of the required station and this is most easily accomplished by shorting the two PCB pins at the top of the 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.

SPECIFICATION

Input configuration	Voltage tuned VHF radio tuner system, for the range 88MHz to 108MHz. On board 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

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. Whenever the TG.1 is oscillating, a signal of approximately 1V RMS at 47K ohm source impedance will appear at the channel input socket and this may be used to drive a remote amplifier etc.

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 15 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 15 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 15 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 15 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 15 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

PRIORITY INPUT FACILITIES

Priority circuitry is fitted as standard to input channel 1, with control access via the channel 1 input socket at the rear, pins 4 and 5. This feature can enable a signal on input No.1 to be given precedence - or priority - over any other input signal except one at the mixer facility connection. It is used for example to mute a music signal whilst simultaneously enabling a paging microphone for example. Simultaneously with this, a current sink device is brought into operation which may be used with the +24 DC output at the Auxiliary output socket.
Additionally, a +15V signal is sent to the printed circuit pins adjacent to channel 1 module socket which may be used for triggering a chime module, for example.
See APPENDIX B for details of how these facilities may be used.

Preparation
The full range of facilities become available on cutting the red priority muting wire link between the module sockets for channels 1 and 2. With this done, and the two ends bent apart, channel 1 becomes normally mute. On shorting pins 4 and 5 of the channel 1 input socket as mentioned above, channels 2, 3, 4, (5, 6) become muted and channel 1 becomes 'live' in a smooth noiseless sequence.
A 24V DC supply, and a priority operated current sink are available at the Auxiliary output socket whether or not the red priority muting link is cut.

Muting level adjustment
Under normal operating circumstances with the priority link cut, channel 1 would be muted whilst the other channels would remain at full sensitivity. On activating the priority circuit the situation would be reversed. Under certain circumstances it may be desirable to provide incomplete or variable muting on the non-priority channels and a small pre-set adjustment is positioned near the centre of the main board in both amplifiers which provides this facility. Clockwise rotation of this pre-set control will provide progressively less muting effect. On the 4 input mixer and amplifier this is therefore operative on channels 2, 3 and 4. However, on the 6 input amplifier the facility is confined to channels 2, 3, 4 and 5, whilst channel 6 is fully muted for the period of any priority operation. This pre-set control is entirely inoperative until the red priority muting link is cut.
For further details of these items see APPENDIX A and APPENDIX D.

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 the appropriate 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 is fitted to Channel 1 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

The customary ding-dong chime signals which can often be heard to precede announcements in public buildings, are generated in the MMA 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 the MMA range equipment.

0dB signal in/out access for MM and MMA units -

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 MMA 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.

For units fitted with a non-standard optional XLR 3 pin connector, the connections will be:-
Pin 1 signal earth (cable braiding)
Pin 2 .775V @ 10K ohms via master control (also access to power amplifier input for MMA units)
Pin 3 .775V @ 600 ohms from the mixer (pre-master control)

Input connections for A.70 and A.140 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

For units where an XLR 3 pin connector has been specified for signal input, the connections are:-

Pin 1 Chassis earth
Pin 2 .775v @ 10k ohms power amplifier input
Pin 3 Signal earth

Signal arrangements and cable connections are shown in Fig. 1
As a factory fitted option, these units 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. See the section on factory fitted options for full details.
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 - page 21.

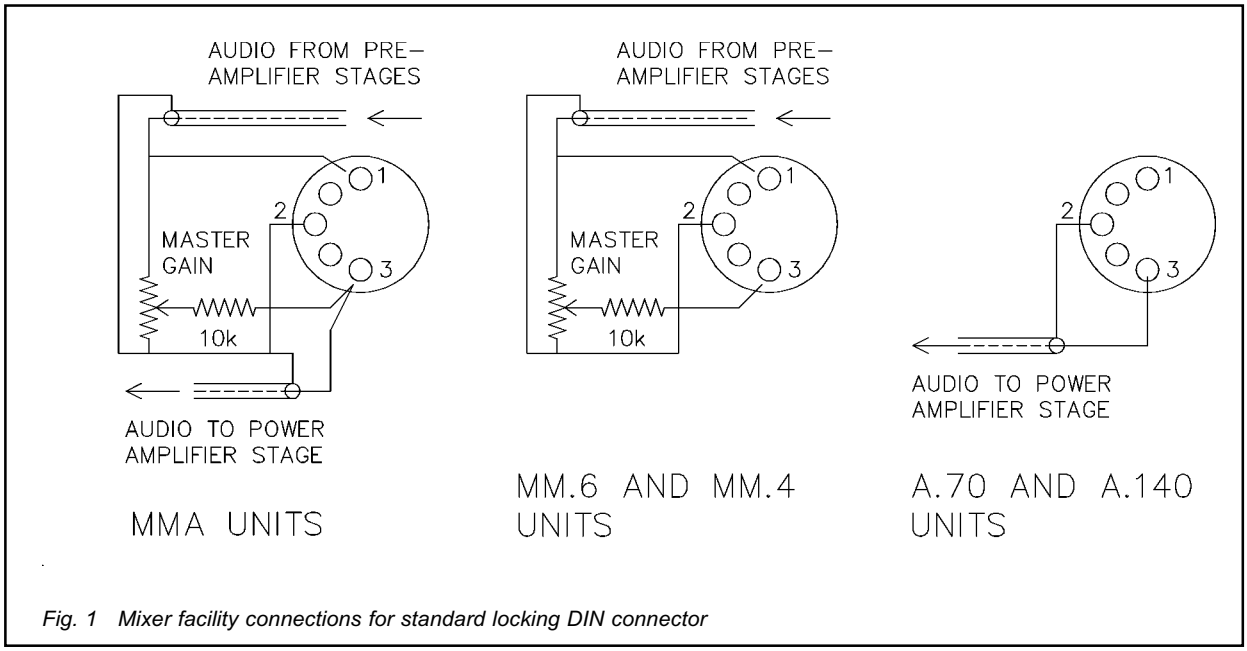


Fig. 1 Mixer facility connections for standard locking DIN connector

Tape recording

The mixer facility socket of an MM or MMA units will provide suitable signals for tape recording, though it will normally be necessary to make up a suitable recording and/or playback lead.
The 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)
Pin3 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.

For units fitted with a non-standard optional XLR 3 pin connector, the pin connections will be:-

Pin 1 signal earth (cable braiding)
Pin 2 signal non-dependent on master gain control
Pin 3 signal via master control

For recording on a stereo recorder connect both left and right channel signal input connections together to pins 2 or 3, as required.

The manufacturer's handbook should be consulted to ensure that the recorder will accept signal levels of approximately 0.75V without distortion and that the recorder does not short out the signal recording connections when in the playback mode. In either case, insert a resistor of suitably high value in series with the recording lead. An experimental starting value would be 22k ohms. See Fig. 2.
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 T.5 or L.5 module which accommodate a wide variety of signal levels. The module would be located in an appropriate module socket. As the L.5 has a floating input circuit, it 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.

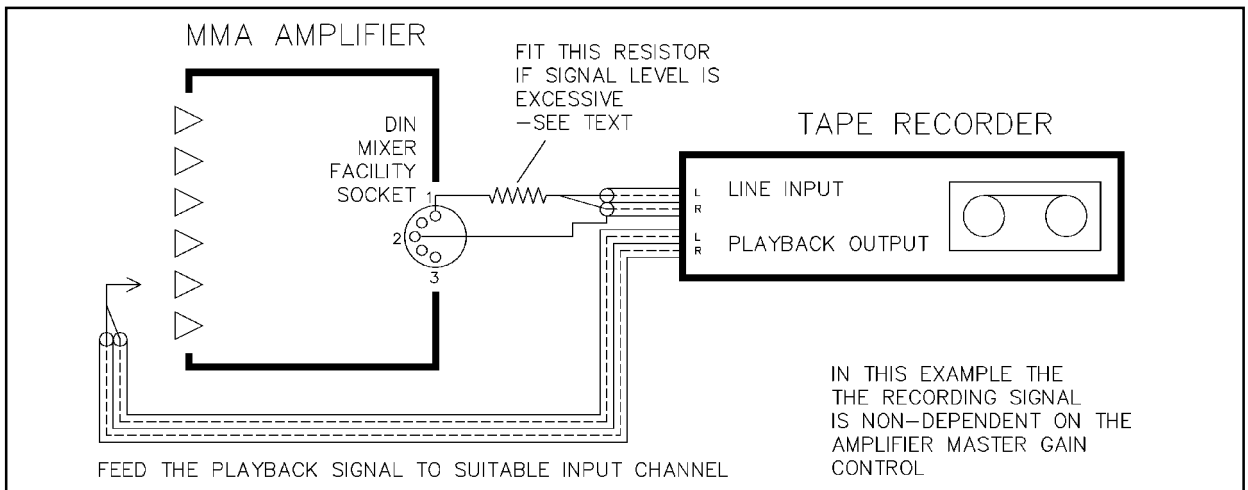


Fig. 2 Tape record and playback connections

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 programme. This is made possible by linking the respective mixer facility socket pin (pre or post master gain) 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. 3 for clarification.
NOTE: This is the only means of interconnection that is permitted. It is most inadvisable to attempt to combine the loud-speaker 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 - MMA and A units

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 very substantial output transistors thermally coupled to a substantial heatsink and the rear panel of the chassis. Factory adjustments are provided for DC offset voltage and output transistor bias, and the module includes dissipation limiting protection circuitry. The basic circuit has been designed to deliver the full rated power direct into loads of 8 ohms, with the output transformer then providing facilities for other impedances and line voltages. For impedance and loads which cause overloading of the amplifier section, the protection circuitry becomes operative progressively. 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.

These topics are covered on page 26 (Maintenance - adjusting the power amplifier)

LOUDSPEAKER OUTPUT

The amplifier is designed to work with low impedance loudspeaker loads of between 4 and 16 ohms, and 50 or 100 Volt line loudspeakers. IT IS ESSENTIAL to provide the correct loudspeaker load for safe and distortion-free reproduction. A new sound system installation should be designed so that the total loading provided by the loudspeaker system is:-

not less than 4 ohms for low impedance systems

or

not more than the rated power of the amplifier for 50 Volt or 100 Volt line systems

For examples of load arrangement see the section “Typical loudspeaker load arrangements” below.

100V line or low impedance?
The decision to plan a loudspeaker system to be of low impedance or to be 50 Volt/100 Volt operation will be influenced by considerations which include:-

the quantity of loudspeakers
the distance between amplifier and loudspeakers
the requirement for a variety of sound levels from related loudspeakers
the permissible degree of power loss in the loudspeaker cabling
the relative importance of system frequency response

The various key characteristics of the two concepts are:

100 Volt/50 Volt line loudspeakers each utilise an inbuilt transformer with several power tapping connections. The loudspeakers are connected in parallel across the loudspeaker line. The transformer taps enables the power consumption of each loudspeaker to be adjusted in order to provide widely differing sound levels. The amplifier is designed to develop a maximum audio signal output amplitude of 100 Volts RMS. The loudspeakers therefore operate at relatively high voltage and low current so that power losses on long loudspeaker lines are relatively low. There is no limit to the number of loudspeakers which may be connected across the line except that the sum of the individual power taps must not exceed the amplifier rating. The volume of individual loudspeakers or groups of loudspeakers is readily controllable remotely from the amplifier. A transformer will inevitably introduce some degree of high-frequency loss and the possibility of low-frequency distortion.
Low impedance loudspeakers are relatively simple but as they do not use transformers, they are less versatile. They are also wired in parallel across the loudspeaker line, but as it is unusual for a unit to have an impedance of more than 16 ohms, the natural maximum quantity that can be combined on one line is four, as most amplifiers cannot accept loads of less than 4 ohms. (It is inappropriate to design a series-parallel loudspeaker system for a serious professional application). Each loudspeaker will deliver the same sound output level. Loudspeaker wiring requires heavy duty, expensive conductors and there is a viability limit to length of line. High power volume controls are very wasteful of power so volume control must be carried out at the amplifier. As just a few loudspeakers must dissipate the power of each amplifier, they will of necessity utilise large cone areas and therefore be most suited to high power music systems.

In essence, 100 Volt line is most applicable to extensive, widely dispersed loudspeaker systems, with remote volume controls and switching where versatility is of more concern than technical excellence of music reproduction. Low impedance loudspeakers are effectively confined to stage and band PA systems, and to discotheque music systems.

Typical loudspeaker load arrangements
The following are acceptable examples of loudspeaker loading arrangements for an MMA range 100 Watt amplifier:

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

b 100 x 1 Watt 100 Volt line speakers = 100 Watts total load to the amplifier

c 4 x 25 Watt 100 Volt line speakers = 100 Watts total load to the amplifier

d 40 x 2 Watt 100 Volt line speakers = 80 Watts total load to the amplifier, and therefore 20 Watts spare capacity for future expansion

e 3 x 25 Watt, and 5 x 5 Watt 100 Volt line speakers = 100 Watts total load to the amplifier

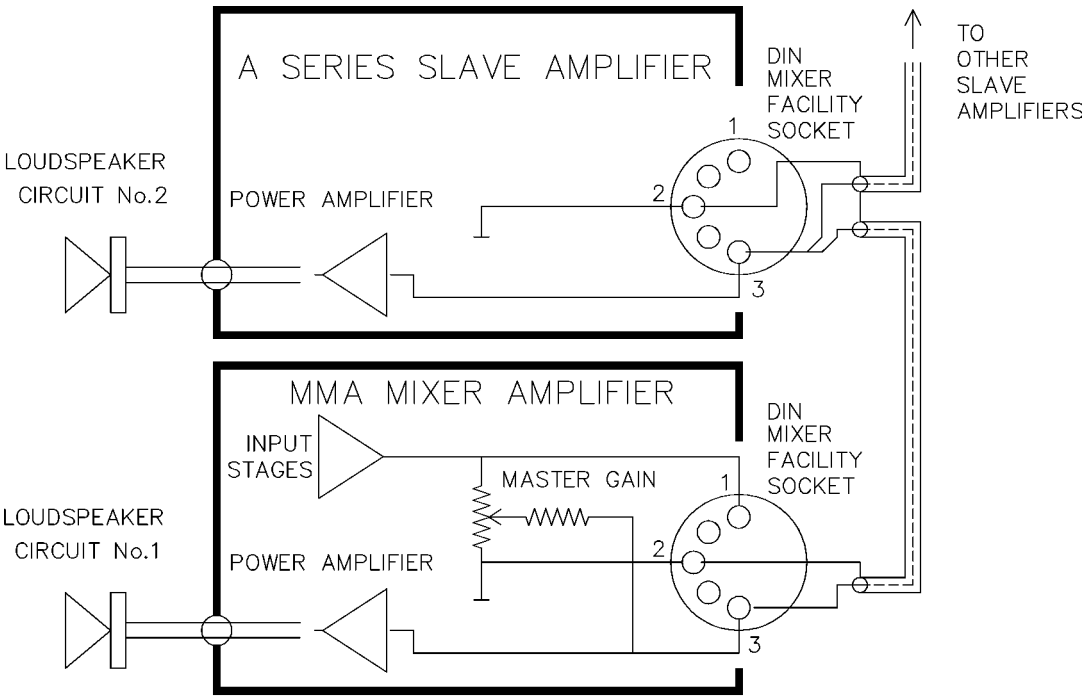


Fig. 3 Interconnection of several amplifiers

f 2 x 60 Watt units each tapped at 30 Watts, and 20 x 2 Watt units tapped as follows: 5 @ 2 Watt, 5 @ 1 Watt and 10 @ 0.5 Watt 100 Volt line speakers = 80 Watts total load and therefore 20 Watts spare capacity for future expansion or for final adjustments.

g 4 x 16 ohm speakers (rated at at least 35 Watts each) connected in parallel across the 4 ohm output terminals

h 2 x 8 ohm speakers (rated at at least 65 Watts each) connected in parallel across the 4 ohm output terminals

j 1 x 4 ohm speaker (rated at at least 130 Watts) connected across the 4 ohm output terminals

k 1 x 8 ohm speaker (rated at at least 130 Watts) connected across the 8 ohm output terminals

For MMA 50 Watt units, the same principles apply, but with alternative load values.
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.

When designing a 100 Volt line loudspeaker system, bear in mind future adjustments which may be required to individual loudspeakers. These may increase the loading beyond safe limits. Some 100 Volt line loudspeakers are also inaccurately rated regarding their power tappings.
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 100 Watt amplifier, then this low impedance load will draw nominally 50 Watts, thereby enabling a further 50 Watts of 100 Volt line loudspeaker load to be connected across the 100 Volt line output terminals.

When connecting an MMA 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 - a conventional multimeter cannot be used for this.

The cover provided on the output socket 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 of the cover free of the stud. The cover may now be swung round clock-wise.

The four loudspeaker terminals at the left of the output socket are for low impedance loads. 0E is internally connected to signal earth whilst the other three terminals are for connection to 4, 8 or 16 ohm loads. The direct output of the amplifier circuitry appears on the 8 ohm terminal.

The three terminals on the right are for 50 Volt or 100 Volt line operation and are free of earth. The terminal marked 0 is a centre tap for this output and under certain circumstances it may be advantageous to connect it to terminal 0E thereby earthing the secondary of the transformer to produce a true balanced line output. The outer two of the three terminals provide 100 Volt output. Alternatively 50 Volts may be taken from between either outer terminal and the 0 terminal.

AUXILIARY OUTPUT CONNECTIONS

This connector provides three outputs which may be used in any combination as required to suit the system design. These are:-

a) 100 Volt line output (duplicate connections to the loudspeaker output terminals)
b) 24V DC positive supply
c) Priority operated DC current sink, for use with b)

The pin connections at the socket are as follows:-

pin 1 priority operated current sink
pin 2 100v line non phase output
pin 3 0E
pin 4 100v line phase output
pin 5 +24v permanent output

100V line output
The 100V line output is a simple alternative connection to the standard loudspeaker output socket and enables completely pluggable connection to a 100V line loudspeaker system, including remote loudspeaker relays etc. The output load should be limited to about 100 Watts via this connection.
For 100 Volt line output, connect between pins 2 and 4. These connections are fully floating and are not associated with pin 3.
This 100V output facility is not available on the MM.4 - MM.6.

24V DC supply
The 24V+ output on pin 5 is unstabilised and is limited to 1 amp by an internal fuse on the main printed circuit board and the return is via pin 3 (0V). This feature would normally be used with the DC current sink. It is not available on the A.70 or A.140.

Priority controlled DC current sink
This 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

The principle of operation is that when the signal priority circuit of channel 1 is activated, the DC current sink is operated. The connection to it - pin 1 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 appearing at pin 5.
The sink is 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. The current sink facilities are not available on the A.70 or A.140.
See APPENDIX B for typical applications of the Auxiliary Output connections.

COMBINING THE LOUDSPEAKER OUTPUTS OF TWO OR MORE AMPLIFIERS

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.

AC MAINS POWER INPUT & AC MAINS FACILITY OUTLET

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.

The AC mains outlet facility is provided for the convenient powering of ancillary units such as tuners, record players, tape recorders etc. This socket is permanently live whilst ever power input is applied to the AC input socket, i.e. it is not switched by the front panel mains ON/OFF switch and is not fused. Do not under any circumstances attempt to draw more than 4 Amps from this socket. Suitable mating connectors are catalogued items available from Mustang Communications Ltd with the product code MF.PL.

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 MMA amplifier in order to break the loop, then this can be found in the rear corner of the chassis adjacent to the voltage selector. Two green wires and one black wire will be seen to lead to the solder tag. Do not disturb the black wire or the green wire leading to the main input socket. Firstly remove the AC power connections from the unit, then carefully de-solder the green wire which leads to the main cable form, insulate it and bend it back. The whole of the MMA audio circuitry should now be free of earth.

A hum loop 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.70 or A.140 amplifiers may be specified with the factory fitted floating 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
Mustang product codes ALC-4 and ALC-6

Where this option is taken up, the standard complement of TB4 tone control module(s) 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;

One TB4-ALC module will be fitted to MM.4, MMA.704 and MMA.1404 units, whilst two modules will be fitted to MM.6, MMA.706 and MMA.1406 units. The option is not normally available on A.70 or A.140 units, but could be specified as a special version. 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.

XLR input connections
Mustang product code XLR.IN (per channel)

Identical input signal functions are provided by XLR connectors and locking DIN connectors. An XLR 3 pin connector will normally be fitted unless specified otherwise, in which case it will be a 5 pin XLR. The latter will have been fitted, only on special request, to take advantage of the priority facility of the input channel to which it is fitted.
Different pin numbers relate to Locking DIN/XLR connectors. Refer to the details of pin connections for standard Locking DIN as shown in the module details above. The equivalents are as follows:-

XLR pin 1 is equivalent to locking DIN pin 2
XLR pin 2 is equivalent to locking DIN pin 1
XLR pin 3 is equivalent to locking DIN pin 3
XLR pin 4 is equivalent to locking DIN pin 4
XLR pin 5 is equivalent to locking DIN pin 5

Do not allow the cable braiding to contact the connector body or an earth/hum loop will result. For further details see the section of this manual which covers earthing and earth/hum loops - page 21.

When a 3 pin XLR connector is fitted to input No.1 of an MM or MMA unit, the priority control wires (normally connected to pins 4 and 5 of the locking DIN socket) are sleeved and left unconnected.

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.

Balanced line input for A.70 and A.140 slave amplifiers
Mustang product code MMA.LT

This option would normally be fitted where difficulty may otherwise be experienced with hum/earth loops. 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
Pin 3 in phase audio balanced (floating) .775V RMS @ 10k ohm

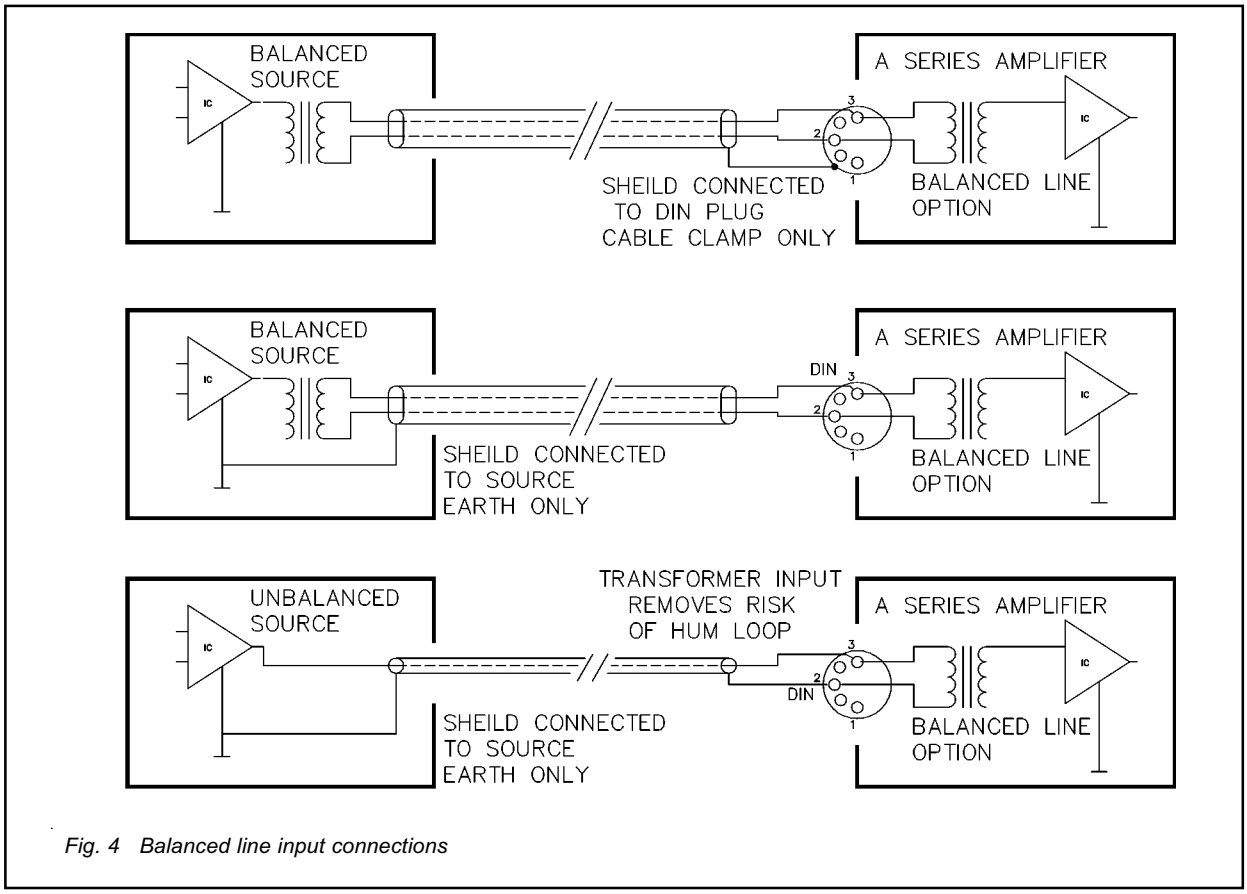


Fig. 4 Balanced line input connections

It would normally be appropriate to interconnect two pieces of equipment using twin-screened cable. The braiding should be earthed to one unit only. If the decision is made to use the Mustang power amplifier for earthing, then the cable clamp of the DIN plug may be used for the purpose, without the likelihood of a hum loop.
As this is a fully floating input facility, either single or twin core screened cable may be used. This will depend upon the specification of the equipment supplying the input signal.
The input impedance of balanced input A.140 and A.70 amplifiers is 10k ohms.
See Fig. 4 for further clarification.

For units where an XLR 3 pin connector has been specified for signal input, the connections are:-

Pin 1 Chassis earth
Pin 2 in phase audio
Pin 3 out of phase audio } .775V RMS @ 10k ohms balanced (floating)

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 overall screened cable, and for longer runs, (up to 10 Mtrs), individually screened cable is advisable. 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 50M, twin conductors of 0.75sq.mm cross-sectional area.

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

c) for 16, 8 or 4 ohm systems, twin conductors of 1.0 sq.mm cross sectional area and the loudspeakers should be no more than 25M from the amplifier.

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.

AC mains voltage selector
Two selection methods are currently in use. Certain models feature a rear-mounted selector switch, marked for selection of 115-220-230-240V. Disconnect the AC supply, pull out the plastic moulding and rotate it until the appropriate voltage symbol lines up with the printed mark on the rear panel, and then push the moulding back in.
Other models feature in internal selector block mounted on the side of the mains power transformer. To adjust this, disconnect the AC mains power, and using a small screwdriver disconnect the brown wire from terminal F (-the factory setting for 240V) and re-instate the wire as follows:

Terminal F	240V - the factory setting
Terminal E	230V
Terminal D	220V
Terminal C	115V
Terminal B	Do not use.

There is no need to change the location of the Blue wire, on terminal A.

Ventilation

Mixers and amplifiers in the MMA range develop very little heat when switched on and not in use. MM mixers develop virtually no heat in use and needs minimal ventilation. MMA 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 the amplifiers are to work hard and/or permanently, then ideally, a 1U spacer should be provided between each 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 MMA 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 MMA 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 1
Priority control out to remote relays, lamps, etc.
Priority audio muting level adjustment
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

The three fuses to be found on the rear panel of the MMA and A series amplifiers and the one fuse on the MM series mixers should be replaced as a matter of routine every year if in regular use. If one of these fuses blows repeatedly, an internal or external fault is indicated. It is unrealistic in these circumstances to suggest a "weak fuse". Do not attempt to force the amplifier by fitting fuses of a higher rating. Ensure that the rear fuse holders are tightened adequately. The two printed circuit fuses to be found on MMA and MM pre-amplifier main mother boards will not normally need to be changed unless a fault occurs.
When replacing fuses, disconnect the AC mains supply and allow a few minutes for capacitors to discharge. The fuses, their functions, values and locations are shown in appendix A.

FAULTS - symptoms & check-list

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.

SYMPTOM	CHECKLIST
1.Sound off, lamp off	Mains fuse, mains lead, mains power, mains switch.
2.Sound off, lamp on	DC fuses, HT voltages, output transistors, input connections, module edge connectors, output transformer continuity, priority muting link, audio switching IC, priority control IC, mixer power supply module, mixer tone control module, mixer AC supply fuse.
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 on bass peaks	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 bass peaksloudspeaker 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 pages 18-20, 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	Insufficient screening on high sensitivity input oscillationsignal 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, audio switching IC, priority control IC.
9.Soft hum - volume controls down	Earth/hum loop, 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 MMA amplifier or ancillary equipment, earth/hum loop - see page 21.
11.Hiss	Excess treble, signal noise incoming from ancillary equipment, unloaded input signal line, noisy input module.
12.Fizz	Interference from dimmers, dimmer lines, faulty fluorescent lights, earth/hum loop - see page 21.
13. Loud harsh hum or buzz	Disconnected signal input braiding, earth/hum loop - see page 21.
14. Intermittent loud crack	Strained input module edge, 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 or booming	Acoustic feedback between or turntables and loudspeakers.
16.DC fuses blowing- fuses blackened	Failed output transistors and/or driver board
17.Mains line fuse blown and blackened	Mains switch suppressor shorted, rectifier failed, mains transformer failed.
18.Channel No.1 off	Priority signal link, audio switching IC, priority control IC, module edge connector.
19. Incorrect signal priority	Audio switching IC and/or priority control IC, priority signal link, priority over-ride control.
20. Incorrect priority - external devices	Priority switching IC, auxiliary DC fuse, auxiliary DC current sink transistor.
21.Intermittent sound	Loose input module or driver board edge connector, fractured input cable, worn volume control track.
22.Mixer AC supply fuse blowing	Mixer power supply module. AC mains transformer failure.

REPAIRS AND MAINTENANCE

Should components be required for replacement purposes, these may be supplied by the dealer or 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 MMA 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 to assist with the most likely problems.

Free-standing case removal
Free standing cased amplifiers are despatched 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 Pozidrive screwdriver.

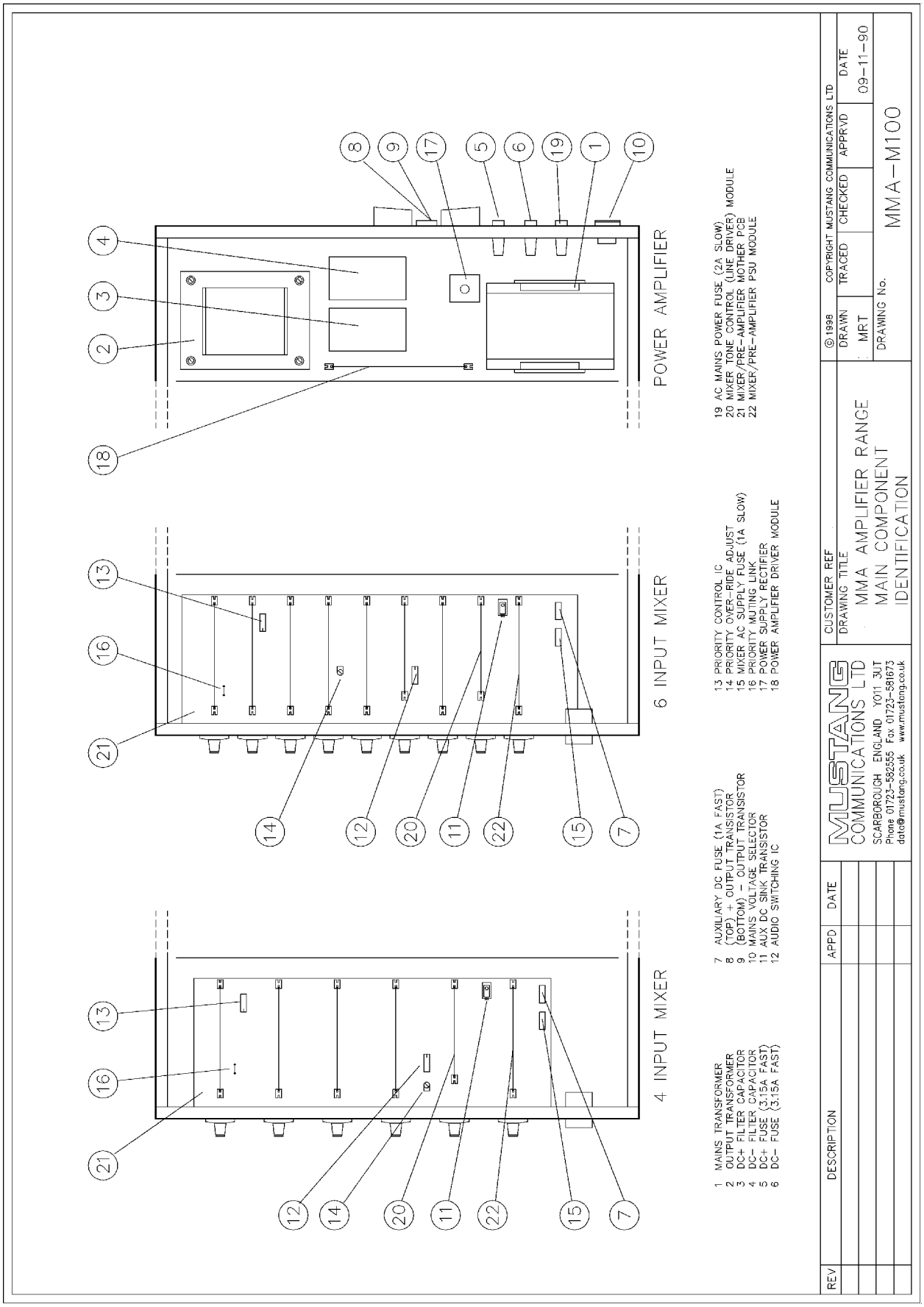
The case is manufactured from PVC clad aluminium and therefore, whilst being washable it will not withstand any direct heat i.e. cigarettes, soldering irons etc.

Removal of main pre-amplifier circuit board - MM and MMA units
Remove the case, control knobs and control nuts. Remove all the modules, noting their locations. Remove four 6BA nuts and washers 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 the 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 - MM and A units
It is advisable to check all the amplifier driver board semiconductors, the large wire-wound resistors, and the DC fuses following failure of output transistors. The output transistors are positioned centrally within the heatsink on the rear of the amplifier and are covered by plastic shrouds which are glued to the transistor cases. Discharge the main power supply smoothing capacitors. Gently prise off the plastic shrouds and unscrew the four bolts securing the transistors to the transistor sockets. Carefully unplug the transistors and replace them with a matched pair using new mica/washers if necessary. Both of these washers should be smeared with heatsink compound to ensure good thermal contact between transistors and heatsink. Do not attempt to use alternative output transistors. Do not trap any foreign matter between transistor and heatsink faces.

Check the amplifier driver board for any damage and replace components or the complete board as necessary. Replace fuses as necessary. Check the edge connections on main driver board and socket, and insert the board. It is now unlikely that any further faults will remain but as a further check connect a voltmeter between the 0E and 8 ohm power output terminals and select a sensitivity of between 2.5 and 10 volts DC. Re-connect the AC mains input to the amplifier and switch on momentarily. If the voltmeter indicates a continuous large deflection then the amplifier should be rechecked for further faults. Technical advice is freely available from our service department.

Adjusting the power amplifier - MMA and A units
The offset control will be found at the top of the main amplifier driver board whilst the output transistor biasing control is located in the centre. Neither of these controls will normally need to be adjusted unless transistors have been replaced on the main driver board, or the output transistors have been changed.
Set the bias control at mid position. Connect a DC voltmeter between the 0E and 8 ohm terminals of the power output connection block. If the amplifier is then switched on from cold, a deflection of no more than approximately 100mV should be observed on the meter. As the circuitry warms to a normal operating temperature, this deflection will drift towards zero. If it does not, adjust the control with a screwdriver or by finger pressure. Re-set again when warm. The bias adjustment which which controls crossover distortion is best carried out using an oscilloscope and signal generator at 25-30kHz. Connect an 8 ohm load in parallel with the meter mentioned above, and feed in a 20mV signal at the mixer facility socket. Using a small screwdriver, adjust the control carefully backwards and forwards until crossover distortion is visible. Then set the control at the point where the observed waveform becomes clean. If necessary re-set the offset control so that the output voltmeter again reads zero. The heatsink block at the rear of the amplifier should become mildly warm. Any appreciable heat would indicate incorrect adjustment or faulty circuitry. If suitable test equipment is not available it would be safer not to attempt to adjust the bias control, but leave it set mid-position. It should be noted that only very fine adjustment is provided by this bias control.

Integrated circuit replacement - MM and MMA units
These are a 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 in APPENDIX A.


POWER AMPLIFIER
6 INPUT MIXER
4 INPUT MIXER
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
14 PRIORITY OVER-RIDE ADJUST
15 MIXER AC SUPPLY FUSE (1A SLOW)
16 PRIORITY MUTING LINK
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
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
MMA AMPLIFIER RANGE
MAIN COMPONENT
IDENTIFICATION
© 1998 COPYRIGHT MUSTANG COMMUNICATIONS LTD
DRAWN
TRACED
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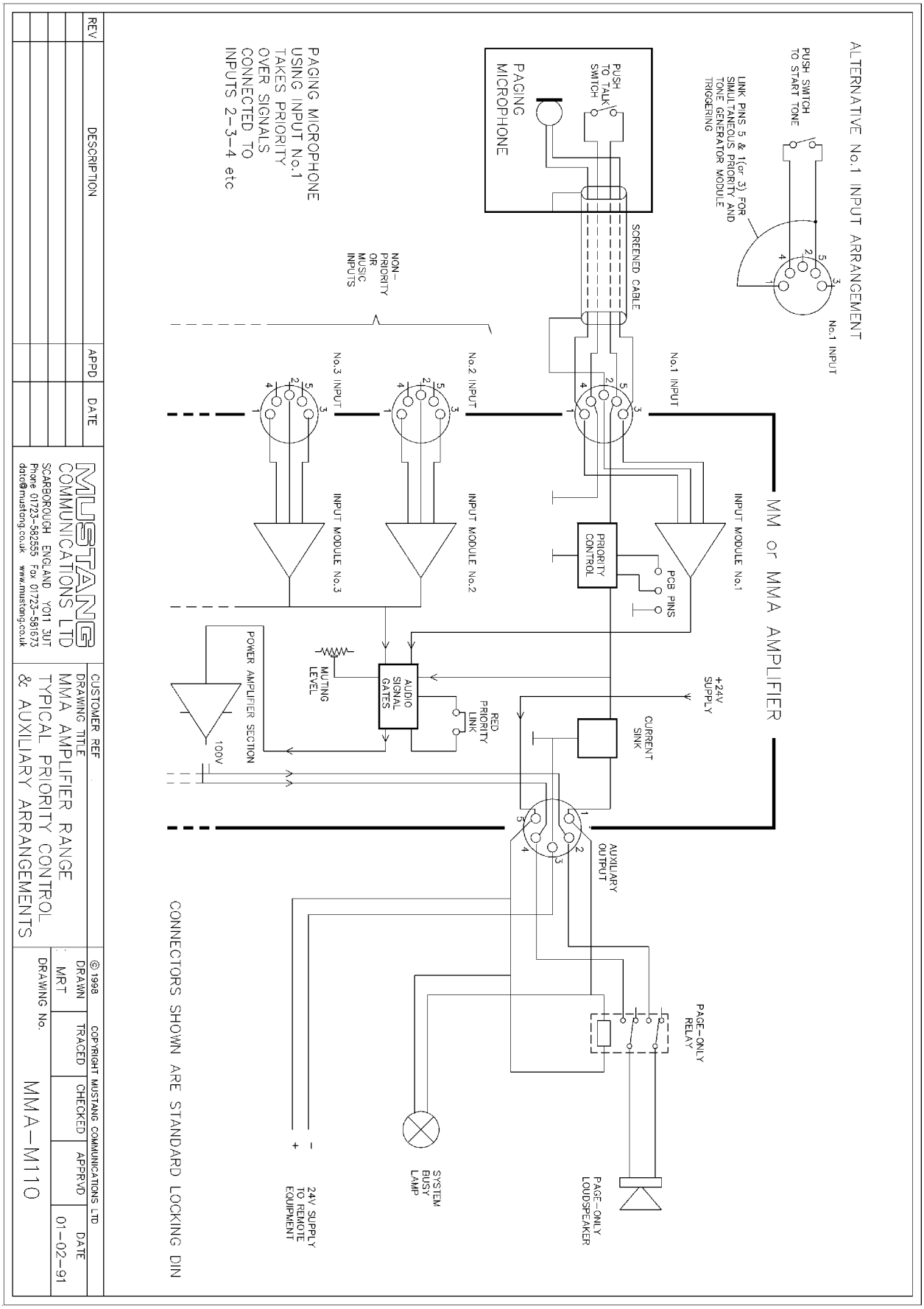
DATE
MRT
09-11-90
DRAWING No.
MMA-M100


ALTERNATIVE No.1 INPUT ARRANGEMENT
PUSH-SWITCH TO START TONE
LINK PINS 5 & 1(or 3) FOR SIMULTANEOUS PRIORITY AND TONE GENERATOR MODULE TRIGGERING
No.1 INPUT
PAGING MICROPHONE
PUSH TO TALK SWITCH
SCREENED CABLE
NON-PRIORITY OR MUSIC INPUTS
PAGING MICROPHONE USING INPUT No.1 TAKES PRIORITY OVER SIGNALS CONNECTED TO INPUTS 2-3-4 etc
No.3 INPUT
No.2 INPUT
No.1 INPUT
MM or MMA AMPLIFIER
INPUT MODULE No.3
INPUT MODULE No.2
INPUT MODULE No.1
PRIORITY CONTROL
PCB PINS
POWER AMPLIFIER SECTION
100V
MUTING LEVEL
AUDIO SIGNAL GATES
RED PRIORITY LINK
+24V SUPPLY
CURRENT SINK
AUXILIARY OUTPUT
PAGE-ONLY RELAY
PAGE-ONLY LOUDSPEAKER
SYSTEM BUSY LAMP
24V SUPPLY TO REMOTE EQUIPMENT
CONNECTORS SHOWN ARE STANDARD LOCKING DIN
REV
DESCRIPTION
APPD
DATE
MUSTANG COMMUNICATIONS LTD
SCARBOROUGH ENGLAND YO11 3UT
Phone 01723-582555 Fax 01723-581673
dotc@mustang.co.uk www.mustang.co.uk
CUSTOMER REF
DRAWING TITLE
MMA AMPLIFIER RANGE
TYPICAL PRIORITY CONTROL
& AUXILIARY ARRANGEMENTS
DRAWING No.
MMA-M110
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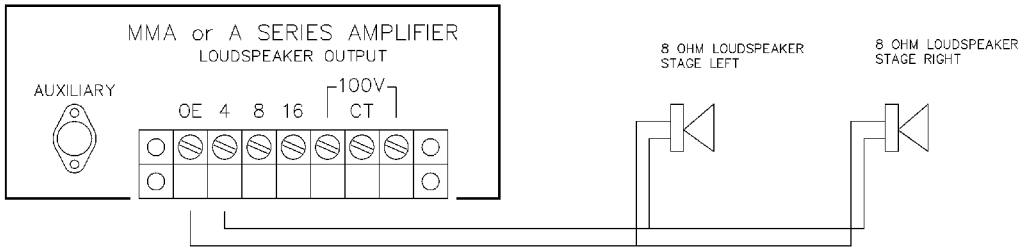
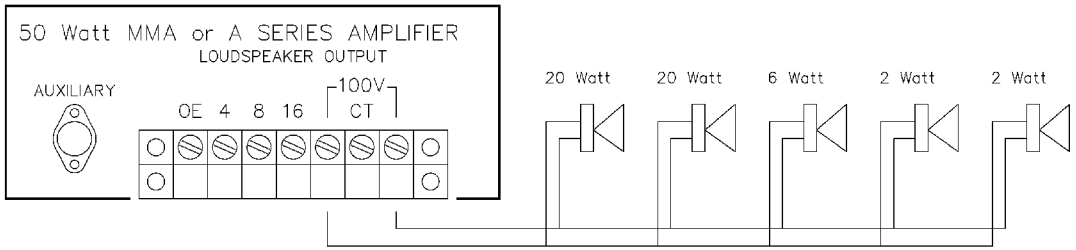


TYPICAL LOW IMPEDANCE CIRCUIT

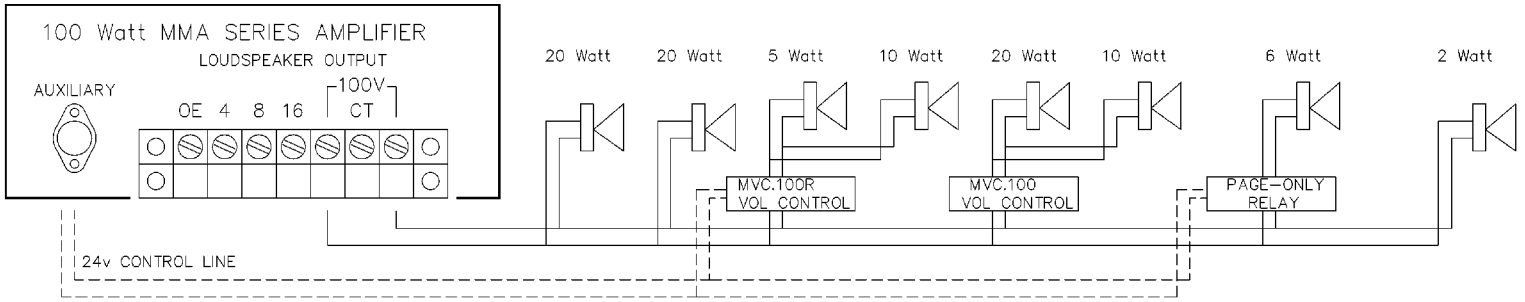
Two 8 ohm loudspeakers wired in parallel across the 4 ohm output of the amplifier.
Alternatively, four 16 ohm loudspeakers could be used in the same manner



TYPICAL 100 VOLT LINE CIRCUITS

Simple circuit in which the total loudspeaker load equals the amplifier maximum power capability

Complex circuit in which sub-circuits are controlled by the priority operation of the amplifier. The maximum possible load presented to the amplifier will be 93 Watts.



REV	DESCRIPTION	APPD	DATE

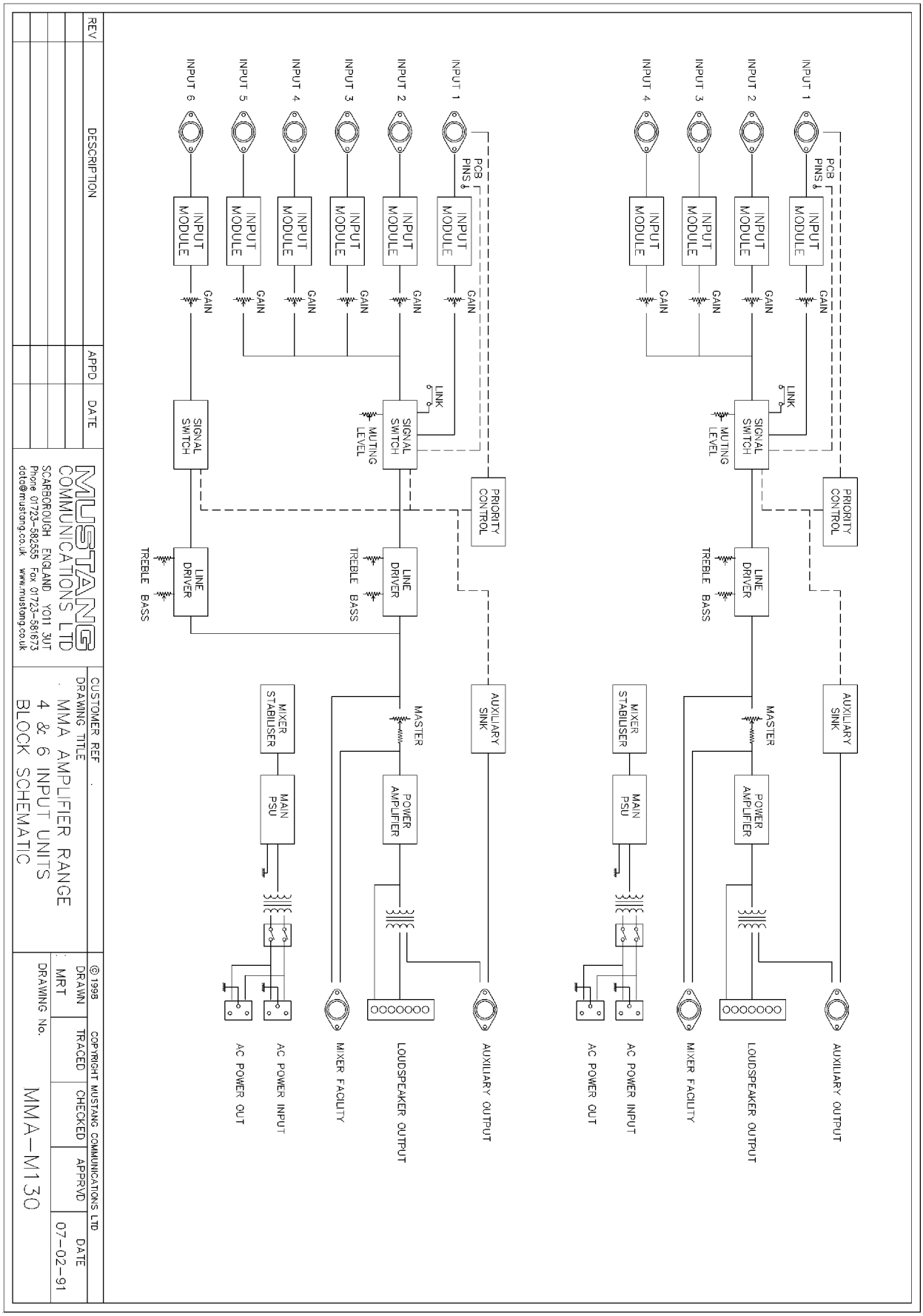
MUSTANG
COMMUNICATIONS LTD
SCARBOROUGH ENGLAND YO11 3UT
Phone 01723-582555 Fax 01723-581673
data@mustang.co.uk www.mustang.co.uk

CUSTOMER REF

DRAWING TITLE
MMA AMPLIFIER RANGE
TYPICAL LOUDSPEAKER
CIRCUITS

DRAWN	TRACED	CHECKED	APPRVD	DATE
MRT				07-02-91

DRAWING No. MMA-M120



REV	DESCRIPTION	APPD	DATE

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CUSTOMER REF

DRAWING TITLE
MMA AMPLIFIER RANGE
4 & 6 INPUT UNITS
BLOCK SCHEMATIC

DRAWN	TRACED	CHECKED	APPRVD	DATE
MRT				07-02-91

DRAWING No.
MMA-M130