

TECHNICAL INSTALLATION STANDARDS

1. PROJECT MANAGEMENT

1.1 GENERAL

1.1.1 Liaison

Upon placement of any Contract, MHz will appoint a Project Manager who will co-ordinate the project, and a Project Engineer to implement the project and attend regular progress meetings as required. This person will be the main point of contact for the Customer, however, the Project Manager will be available to ensure that the project is kept on track. Ultimate responsibility for all projects undertaken by MHz lies with the Project Board. A generic family tree of responsibility for project work can be found in the Megahertz Installation Practices Handbook.

1.1.2 Approval of Drawings

During the design phase, MHz will submit drawings to the Customer for approval before commencement of work. The timescale for approval of drawings must be agreed at an early stage in the project.

1.1.3 Acceptance Tests on Third Party Equipment

When deemed necessary MHz will perform or attend acceptance tests on third party equipment to be provided for a Contract.

1.1.4 Prefabrication

In general, MHz prefer to prefabricate systems in its own premises prior to installation. This ensures on-site time is reduced minimising costs and disruption to the Customer.

During this period of prefabrication, MHz anticipate that the Customer would regularly send a representative to the factory in order to review progress and deal with queries as they arise. Whilst on the premises, the Customer will be expected to comply with all MHz Health & Safety Policies. In particular it should be noted that no smoking is allowed inside any of the buildings.

A copy of the MHz Health & Safety Manual is available in CD form on request.

1.1.5 Embodiment Loan Equipment/Insurance

It may be necessary for the Customer to supply MHz with equipment for incorporation into a system. MHz will undertake to provide adequate "all risks" insurance (this is limited to £800,000 unless we are advised otherwise) for this equipment whilst it is on MHz premises and whilst it is being transported by MHz.

In addition, MHz and its sub-contractors carry a public liability insurance. This is £2M in the case of MHz.

1.1.6 Design Changes

During the design and installation of a project it is accepted that a number of changes in requirements are inevitable. The Customer should nominate a representative from whom MHz will exclusively take instructions for changes. Where these changes involve additional work, cost or increase in timescale above that already quoted, the MHz engineer will provide a written quotation on the standard change form and will require written authorisation to proceed before the changes are implemented. Similarly for a reduction in the amount of work or cost, a quotation for the amount of reduction will be provided.

1.1.7 Final Acceptance

Following satisfactory testing by MHz engineers, the system will be offered for final acceptance to the Customer. When testing is complete, the Customer will be expected to sign a Preliminary Acceptance Form, which may include a “snag list” and an agreed timescale to clear the snags in order to achieve full acceptance.

1.1.8 Technical Information

Prior to final acceptance MHz will present the Customer with a complete set of documentation. Following final acceptance MHz will provide a number of copies of documentation presented in loose leaf binders (exact number to be agreed). In addition to hard copies of the information, drawings can be supplied on CD in either FastCad, AutoCad V14, or DXF format and wiring schedules will be supplied on a Microsoft Excel compatible spreadsheet. Krone Block schedules can be supplied either on a specific customer Krone Program or a Spreadsheet. An equipment list for all MHz supplied equipment will also be provided complete with serial numbers where appropriate. This list can also include any Customer supplied and transferred equipment by agreement. If there are special requirements for the drawings, wiring schedules, etc (eg layers, formats, borders) then these should be agreed before commencement of a project.

The content and layout of the final handbook will conform to the sample described in the Megahertz Installation Practices Handbook.

1.2 ON-SITE WORKING

1.2.1 Safety

MHz employees and their sub-contractors will be expected to fully comply with the local safety specifications, and particularly all relevant parts of the Health and Safety at Work Act 1974, including the Control of Substances Hazardous to Health, the Electricity at Work regulations and the Noise at Work regulations.

It is normal to hold a Safety Meeting prior to commencement of on-site work to ensure that Fire and Evacuation procedures are completely understood.

1.2.2 COSHH

MHz maintain a file containing COSHH certificates for all hazardous substances used. All MHz employees and sub-contractors should be made fully aware of the precautions required when using these substances. Copies of COSHH certificates for substances brought on site can be made available on request.

1.2.3 Restaurant

MHz staff and sub-contractors would normally expect to be allowed access to staff on-site restaurant/tea bars.

1.2.4 Cleaning and Waste Disposal

MHz will ensure that their working area is kept clean and tidy. The Customer should advise what facilities are available for waste disposal.

1.2.5 Working Hours

On-site working hours are to be agreed, however, it is normal for hours of 7am to 7pm to be worked and weekends if deemed necessary.

1.2.6 Security Passes

MHz will provide details of on-site staff on request so that any appropriate Security Passes may be issued.

1.2.7 Car Parking

The customer should inform MHz of car parking arrangements.

1.2.8 Telephone, Fax, Photocopy

During the installation process it may be necessary to have access to these facilities. The Customer should advise MHz if any charges will be made for their occasional use.

The Customer should identify any areas where the use of mobile telephones is not permitted.

1.2.9 Smoking

It is not MHZ practice to allow its employees or sub-contractors to smoke in the installation area. The Customer should advise of areas where smoking is permitted.

1.2.10 On-Site Security

Whilst on-site, MHZ would expect that a secure area be made available so that tools and materials may be left safely. The Customer should advise if this will not be possible so that alternative arrangements can be made by MHZ.

1.2.11 Noise

The customer should make clear to the MHZ on-site representative where and when the generation of noise would be unacceptable.

1.2.12 Loading/Unloading

The Customer should indicate the facilities available for loading/unloading large items and advise access routes available to the installation area.

2. GENERAL TECHNICAL STANDARDS

2.1 MECHANICAL INSTALLATION

2.1.1 Layout

Rack layouts will be decided and agreed with the Customer prior to installation with due consideration to operational aspects, ventilation (allowing 1RU between equipment known to generate heat) and air flow (deeper items located towards the bottom of the rack).

Reference should be made to the relevant section of the Megahertz Installation Practices Handbook when deciding the rack layout.

2.1.2 Supports

Where practical and appropriate, equipment supports will be fitted to the bays to reduce the risk of accidents during equipment removal. Care will be taken to avoid restricting any side vents when fitting equipment supports.

2.1.3 Equipment Fixings

Equipment will be fixed in bays and desks using chrome finish Posidrive screws, plain washers and plastic cup washers. When appropriate, as in black monitor stacks, equipment will be fixed using black finish screws.

Details of equipment fixing can be found in the Megahertz Installation Practices Handbook.

2.1.4 Bay Fixings

If required, a wooden plinth can be provided for the bays fixed to the floor. The bays will be fixed to this. Otherwise, bays and monitor stacks will be fixed directly to the floor. Desks are normally left free-standing.

2.2 TECHNICAL WIRING

2.2.1 General Standard

In general, MHz will follow the wiring standards layed down in the BBC publication ED122.

2.2.2 Looming

All cables will be loomed to cable trays in bays, desks and monitor walls. MHz will follow any Customer practice for cables under floors and in ducts. High quality plastic tie wraps are used which are cut using an appropriate tool to ensure no sharp edges remain.

2.2.3 Cable Separation

Wherever practical video, audio, control and power wiring looms will be kept separate.

2.2.4 Maintenance

In cases where access to the rear of the equipment is limited, all cables will be left long enough such that equipment and jackfields can be withdrawn forward for maintenance purposes.

2.2.5 Analogue Video Cable and Connectors

In general, 4.5mm OD, double-screened coaxial cable will be used for all applications, including analogue video and runs below 80m. By special request and where space and weight capacities allow, PSF style video cable can be used which does tend to allow better equalisation (depending on the manufacturer of the equalisers).

For analogue video cable runs between 80 and 100m, PSF 1/3M type or equivalent with a cream coloured outer sheath will be used. For runs between 100m and 300m PSF 1/2M will be used.

Whichever cable is used, the same type will be carried through any interface points and jackfields up to the next equalising DA in the chain.

High quality, gold pin BNC connectors will be used (eg Transradio Q93717A) together with colour coded strain relief boots (colour coding is to be agreed with the customer before commencement of the project, otherwise the colour coding described in the Megahertz Installation Practices Handbook will be used). High quality 75 Ohm 1% terminations will be used as required. BNC connectors will be crimped using the appropriate crimp tool and jaws.

2.2.6 Digital Video Cables and Connectors

Serial digital video installations should be capable of passing 360Mbits/sec with loss less than approximately 30dB. In general, 4.5mm OD, double-screened coaxial cable will be used for Serial Digital Video applications up

to lengths of approximately 100m. PSF1/3M video cable can be used for runs up to 110m (this gives a loss of around 24dB). PSF1/2M cable will be used for lengths between 110 and 160m.

High quality, gold pin BNC connectors (75 ohm impedance) will be used (e.g. Transradio Q93717A) together with colour coded strain relief boots (colour coding to be agreed with the customer before commencement of the project, otherwise the colour coding described in the Megahertz Installation Practices Handbook will be used). BNC connectors will be crimped using the appropriate crimp tool and jaws.

Terminations used will be 75 Ohm, 1%.

2.2.7 Video/RF Terminations

All unused video or RF outputs from equipment will be fitted with appropriate terminations. Whenever practical, spare outputs appearing on patch panels will be normalised to a termination either on the input of another piece of equipment or on a dedicated terminating jack.

2.2.8 Video Patch Panels

Video patch panels with musa connectors on the front and BNC connectors on the rear are normally used for video patching. Musa U-links are used to connect upper rows (signal sources) to lower rows (signal destinations). Other types of patch panels can be used on request. Video patch panels with monitoring points are not used unless specifically requested by the customer.

Examples of the wiring methods applied to video patch panels can be found in the Megahertz Installation Practices Handbook.

2.2.9 Interface Panels

As an aid to prefabrication, video cables external to the bays will normally pass through a BNC interface panel located in an appropriate bay.

2.2.10 Audio Cable and Connectors

For line level analogue audio, MHz POS (NEK PSN) type cable will be used. For audio signals in a hostile environment, either individually screened pairs will be used or MHz PIS (NEK PIN) type cable (individually screened and jacketed pairs). Individually screened cables will also be used for timecode. Star quad or "J-type" cable will be used for microphone feeds.

Colour coding for the cable cores will follow that described in the Megahertz Installation Practices Handbook.

Where practical all unused cores of multi-core cables will be terminated at both ends. The screen will be earthed at the interface frame only, or in the absence of an interface frame, at the jackfield. If the signal does not pass through an interface frame or a jackfield then the screen should be earthed at the sending end. All unused jacks on the jackfields will be wired to the interface frame.

Connectors used will normally be XLR type or Varicon (516). Exact details for wiring these connectors are specified in the Megahertz Installation Practices Handbook.

Audio signals appearing on jackfields will be balanced and line level (except when clearly indicated otherwise).

2.2.11 Audio Impedance

All analogue and timecode circuits will be installed and tested assuming a low source and high load impedance. Unless specifically requested by the Customer, 600 Ohm terminating resistors will not be fitted.

2.2.12 AES/EBU Digital Audio Cable

Unless otherwise specified MHz will use 110 Ohm, balanced cable for AES/EBU digital audio signals.

2.2.13 Audio Patch Panels & Normalling

Generally, unless capacity or local practices dictate otherwise, ¼" BPO B-gauge, audio patch panels will be used.

Generally, unless specifically requested, jackfield normalling is done on the rear of the jackfield rather than on the interface frame.

Analogue audio and timecode jackfields are usually half normalled, ie the hot and cold of the upper row outers are wired to the hot and cold of the lower row inners. The sleeves of the jacks are bussed and connected by a single earth wire per row to the bay earthing point.

Microphone circuits are not usually taken through jackfields, however, if this is required, they will be normalled, hot and cold of the upper row inners to hot and cold of the lower row inners. This prevents microphone circuits from being paralleled. The jack sleeves are also normalled from upper to lower row but not connected to earth.

Digital audio circuits are normalled in the same way as specified above for microphone circuits.

Examples of the wiring methods applied to audio patch panels can be found in the Megahertz Installation Practices Handbook.

2.2.14 Krone Blocks

To avoid possible crosstalk problems on the Krone frame, the blocks will be grouped into 3 areas i.e. analogue audio, AES audio and timecode. For analogue audio and timecode 237A disconnection blocks are used. For AES audio ABS blocks are used with individual screens.

Jumpering will always be supported by jumper rings and will be done neatly, ensuring the tag numbers remain visible.

Jumper cables are normally colour coded according to function. Colours to be agreed prior to installation. Jumper cable will only be used within a single interface frame, i.e. it will not be used between frames in different areas.

Jumper cable will be BT CW1257 type, which resists chaffing when jumper cables are pulled through the frame.

Examples of the wiring methods applied to Krone blocks can be found in the Megahertz Installation Practices Handbook.

2.2.15 Control Cables

Control cables will be chosen depending on the application but in general flat ribbon cable is not used.

Due to EMC considerations, all cables, other than those carrying DC, will be screened. In addition, metallised covers will be used wherever possible.

2.2.16 Power Cables

Power cables will be chosen according to usage. From the main distribution point (e.g. consumer unit) to the bay, desk or monitor stack, armoured 3 core mains cable will be used with the screen taken to general purpose earth, or the cables will be run in conduit. In-line BS4343 connectors, or some other kind of junction box, will then be provided to allow local mains isolation for each bay, desk or monitor stack, and orange PVC sheathed 3 core cable will be used from the BS4343 connector to the mains distribution unit and from there to the equipment. Where possible retaining clips will be fitted to the mains input of all pieces of equipment.

IEC power connectors will be wired according to the Megahertz Installation Practices Handbook, taking care to ensure that the earth cable is longer than the live and neutral so that it disconnects last if the cable is wrenched out of the plug.

2.2.17 RF Cables

RF cables will be chosen according to equipment manufacturer's recommendations, taking special care over connector impedance and terminations.

Generally, MHz will attempt to keep all transmit and receive paths at 50 Ohm, although impedance converters will not be used unless essential. N-type connectors are the preferred choice although, if the connection must be 75 Ohm, TNC's will be used. BNC connectors will be avoided at frequencies above 1GHz, because practical experience has shown that only

some manufacturer's product gives a satisfactory frequency response. F-type connectors are not normally used due to their mechanical weaknesses and F&E connectors (otherwise known as series 83 or UHF connectors) will be avoided due to their non-determinant impedance.

2.2.18 Earthing

A star earthing system will be employed. Runs from the central earthing point of the area will be in 16mm² stranded green/yellow cable. Each bay/desk will have an earthing point to which these cables terminate, then 6mm² cable will be used to bond all exposed metalwork to these earthing points. When bonding exposed metalwork, construction fixings will not be used, instead, dedicated earthing screws will be used with shake-proof washers.

It is not MHz normal practice to take a separate individual earth cable to each piece of equipment, unless it has been specifically requested by the Customer or is appropriate for a particular installation. All earth cables will be terminated using the appropriate sized crimps.

2.2.19 Solid Core Cable

Solid core cable (except for video and RF cable) is not normally used for mobile installations, or to connect to equipment which is on sliders or pull-out trays.

2.3 ELECTROMAGNETIC COMPATIBILITY (EMC)

2.3.1 Equipment CE Marking

As from 1 January 1996, all equipment to be incorporated in a MHz installation within the EEC must have a CE mark indicating that it complies with all the relevant directives applicable to that product at the time of manufacture. Alternatively, if the equipment is of a custom, one-off nature, then it must be supported by a Technical Construction File (TCF) indicating that it has been designed and constructed to meet the applicable directives.

MHz will be prohibited by law from incorporating any equipment into an installation in the EEC which does not comply (free-issue equipment, for

example). Naturally, provision can be made in the installation for such equipment as the customer requires, however, the installation has to be handed over without this equipment.

2.3.2 EMC Testing and Conformity

It will normally be impractical to test installations for EMC immunity or emissions.

In the case of immunity, it is unlikely that the installation can be totally isolated from the surrounding infrastructure and any attempt to subject the new installation to electromagnetic radiation is very likely to disturb the rest of the site.

As for emissions, it seems that it will be extremely difficult to measure any contribution from the new installation above the background radiation from the existing infrastructure.

However, it is Mhz intention to test both fixed and mobile installations whenever possible in order to build up a database of test results to enable accurate predictions of any potential problem areas.

A Technical Construction File (TCF) will be prepared for each installation ensuring that the system is installed in a manner which experience shows, is unlikely to be susceptible to, or generate electromagnetic radiation.

The above measures, together with the fact that all installed equipment will be either CE marked, or accompanied by a TCF, and will be installed according to manufacturers' recommendations, should ensure that the installations are fully compliant with EMC regulations.

2.4 CABLE MANAGEMENT

2.4.1 Cable Numbers

All cables will be uniquely identified at each end by a cable number and/or a letter which will allow cross referencing to the wiring schedules and drawings. Cable numbers used will be the plastic coloured type as supplied

by Partex and will be fitted according to the Megahertz Installation Practices Handbook.

Allocation of numbers will be agreed by the Customer before commencement of the project.

2.4.2 Cable Identification

Where equipment is likely to be regularly removed (eg VTR's for maintenance, etc), and where specifically requested by the Customer, cables will be given a label describing where it is plugged in. These labels will be created using the "Brady Marker System" and will be in addition to the number described above.

2.4.3 Jackfield/Krone Numbering

Unless specifically requested by the Customer, the jackfields will be uniquely identified by bay number, row letter, (A being the top row of the top jackfield, B being the bottom row of the top jackfield) and jack number (from the left).

Krone blocks will be identified by area, then by a letter for the column (A being the left most column), by a number for the height (1 being the top Krone block) and finally a number for the pair of that block (i.e. 1 to 10, left to right).

2.5 CUSTOM MADE UNITS

Where custom units are to be manufactured by MHz as part of a project, the following standards shall apply

2.5.1 Mechanical Construction

In general, units will be designed for ease of maintenance, with plug-in modules.

All mains powered units will be completely enclosed in boxes, not in open frames.

Front panels will be constructed of 3mm aluminium, suitably strengthened where appropriate.

Front panel screws will be counter sunk or raised instrument head.

Front panels will be painted RAL7037 unless specifically requested by the customer.

2.5.2 Mains and Safety

All mains terminals will be covered to ensure the unit is safe, even during maintenance.

Access to any mains terminals will require the use of a tool.

Mains warning labels will be fitted to the outside of any equipment containing mains voltages.

Normally, a mains on/off switch is not provided, however, if one is required, it will be double pole and fitted as close to the incoming mains as possible and before the fuse.

Mains fuseholders will be the type which prevent possible contact with any live parts when changing the fuse.

A single fuse only will be fitted to the incoming live circuit.

All mains fuses will be ceramic filled (not glass construction).

A label will be fitted as close as possible to the fuseholder indicating the type and rating of the fuse fitted.

2.5.3 Earthing

For mains powered units all exposed metalwork will be earthed.

Rear panels will be fitted with an earthing post, suitably labelled, with a removable jumper to the equipment 0V.

Earth posts will be of brass or plated steel construction and assembled as shown in the Megahertz Installation Practices Handbook.

2.5.4 Switches, Controls and Indicators

Switches and pushbuttons will be high quality, designed for a 10 year life.

All button legends will be printed onto removable transparent film.

All powered equipment will have some form of indication on the front panel to indicate that power is on.

When possible LED's will be used for illumination rather than bulbs.

Indicators in general should be coloured green to show normal operating conditions and red for faults and other warnings.

Panel legends will be engraved and paint filled in an appropriate colour.

2.6 POWER INSTALLATIONS

2.6.1 Colour Coding

The following colour coding will be used:

Green & Yellow	-	Earth
Blue	-	Neutral
Brown	-	Live (single phase)
Black	-	Live (three phase)

2.6.2 Terminals

A spring loaded connection system, such as Wago, will be used in mobile installations so that the terminals will not come lose with vibration. Ferrules are not normally fitted if this type of terminal is used, however, if the standard screw terminals are used, then ferrules will be fitted.

2.6.3 Circuit Breakers

Circuit breakers are chosen to protect cable and the input stage up to the next protected point in the distribution chain. Normally, the thermal magnetic type will be used, however, if requested by the customer, the magnetic type can be used due to their immunity to heat effects.

All circuit breakers will be accessible from the front panel of the power distribution unit. Fuses for meters, contactors and other secondary functions may be located inside the power distribution unit. All fuses used for mains will be the ceramic filled type (not glass).

2.6.4 Labelling

Suitable warning labels will be fitted to any power distribution units and access to any live parts will require the use of tools. Cables within power distribution cabinets will be uniquely numbered as will the terminals to allow easy reconnection of any cable by reference to the appropriate installation drawings. All circuit breakers will be clearly labelled as to their function.

2.6.5 Input Earthing on Mobile Installations with Transformers

In general, the earth provided up the power cable will not be connected into the vehicle power system if an isolation transformer is fitted. The input panel, transformer, casing and any other connections or cables associated with the primary side of the transformer will be double insulated. The transformer screen and the neutral from the secondary of the transformer will be taken to the earthing "W" along with all the other earths from within the vehicle. The earthing "W" will have the provision for connecting an earth spike.

The primary side of the transformer may be protected by fuses if requested by the customer. An earth leakage circuit breaker (ELCB) will be fitted in circuit close to the secondary side of the transformer.

Incoming phase may be indicated by neons fitted between live, neutral and earth if required (green to indicate good and red to indicate a fault condition).

2.7

DESK CONSTRUCTION

Where desks are to be supplied as part of a project, the following standards will apply:-

- a) Main construction will be from 19mm high quality plywood, or MDF.
- b) Surfaces will be finished in a hard wearing and durable material, exact nature and colour to be agreed prior to construction.
- c) Any desk legs are normally constructed from 100mm x 50mm x 3mm steel tubing suitably painted and stove enamelled.
- d) Front edge buffer strips are normally finished in a solid hardwood to match the finish of the desk.
- e) Desks are normally constructed in modular form for ease of transportation and installation.
- f) Due care will be taken to provide adequate ventilation to equipment known to generate heat.
- g) Adequate cable routes will be provided in the desk with cable tray fixed to the desk carcass. "Cable Tidies" are installed where cables exit the top of the desk (eg to monitors).
- h) All exposed metalwork will be connected to a single earth point by 6mm² green/yellow cable for bonding to the main technical earth. Dedicated screws with shake proof washers will be used to attach the earth cables, construction screws will not be used.
- i) Whenever possible any tropical hardwood timber used will be from managed sustainable sources.
- j) Mock-ups of complete or parts of desks can be arranged, however this would incur additional costs.

3. TESTING AND COMMISSIONING

3.1 SAFETY

Before powering up equipment, if MHz have been responsible for the main power distribution cabinet, then PAT tests will be performed to check for earth continuity and live/neutral to earth isolation.

All mains leads will be checked using a suitable test fixture. A sample of the mains connectors will be opened to check for correct and safe termination. All of the electrical installation will be checked in accordance with the current IEE Regulations. An appropriate test certificate can be issued if required.

MHz cannot be held responsible for meeting local power regulations unless full details of the requirements are made clear prior to installation.

3.2 COACHBUILDING ACCEPTANCE

If MHz have been responsible for the supply of vehicle coachbuilding services, then a detailed checklist will be prepared. A sample checklist is available in the Megahertz Installation Practices Handbook.

3.3 CONTINUITY TESTING

All installed cables will be checked for continuity and phase before measurements are begun.

3.4 SPECIFICATIONS

Prior to measurement tests, a number of critical paths will be identified and these paths will be checked to a set of agreed specifications. MHz would expect that a representative of the Customer would be present to witness these tests. Where the appropriate test equipment is available, MHz will provide print-outs of these test results for incorporating into the finished documentation.

Samples of test procedures and results for previous projects completed by MHz are available in the Megahertz Installation Practices Handbook.

3.5 **FINAL HANDOVER**

During the acceptance tests (and, where possible, during the installation) the MHz engineer should be made aware of any parts of the installation not considered satisfactory to the Customer (see section 1.1.7). The completion of these items, together with the handing over of an agreed number of sets of documentation would normally constitute the final handover of the project.

3.6 **WARRANTY**

All units manufactured by MHz and all cabling and connectors installed by MHz are guaranteed for a period of 12 months from the date of final handover.

“Third Party” equipment supplied by MHz for incorporation into a project carries the normal manufacturers warranty unless otherwise agreed.

3.7 **TECHNICAL SUPPORT**

MHz operate a 24 hour, 7 day technical support line. If calling during normal UK office hours, the customer will be able to speak with an engineer. If calling outside these hours, the system will automatically alert the engineer on duty, who will return the call as soon as possible.

3.8 **PHOTOGRAPHS/PUBLICITY**

It is normal for MHz to take photographic records of an installation for its own internal purposes. In addition, MHz may request to use photographs and descriptions of this installation for publicity purposes - the Customer should indicate their willingness to allow this.

3.9 **ARCHIVES**

MHz will normally maintain confidential archive records of all "as installed" drawings. The Customer may wish to make use of this facility in the future.