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Box Contents

- 1 x FSM
- 2 x Batteries
- 1 x Pouch
- 1 x CD of test signals
- 1 x 'User Handbook' inc AFILS Test / Commissioning Procedure
- 1 x 'Designing Induction Loops Handbook'
- 1 x Certificate of conformity




This symbol is used to alert the user to important operating or maintenance instructions.



The Lightning bolt triangle is used to alert the user to the risk of electric shock.

SAFETY

1. It is important to read these instructions, and to follow them.
2. Keep this instruction manual in an accessible place.
3. Clean only with a dry cloth. Cleaning fluids may effect the equipment.
4. Refer all servicing to qualified personnel. Servicing is required when the apparatus has been damaged in any way, such as a power supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to any rain or moisture, does not operate normally or has been dropped.
5.  **WARNING** – To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture. The apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, such as vases, shall be placed on the apparatus.



CAUTION
RISK OF ELECTRIC SHOCK
DO NOT OPEN




TO PREVENT ELECTRIC SHOCK DO NOT REMOVE THE COVER. THERE ARE NO USER SERVICABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL.

INTRODUCTION

The Field Strength Meter (FSM) has been designed as a high quality piece of test equipment incorporating true RMS detection for evaluating the performance of Audio Frequency Induction Loop Systems (AFILS) to the international standard IEC 60118-4.

It is simple to use with all types of installation from simple counter loops through to low spill designs.

Three modes are available to investigate the key parameters of AFILS:

Background noise		to examine other magnetic noise
Field strength		to test system magnetic field strength
Frequency response		for measuring system bandwidth

The unit is designed to be used by holding it in the same position as the hearing aid will be once the system is operational: i.e. hold the unit at head height to take measurements: either seated, or standing depending on the venue.

A headphone socket and volume adjustment is provided to allow audible monitoring and subjective testing of the system.

A test CD with 3 signals is provided for use with the meter. These are pink noise, 1kHz sine, and a combination signal which is made up of the other two.

Details of use are given in the AFILS test and commissioning procedure.

All you will need is an installed AFILS with a CD player fed into the appropriate input, and a clear idea of the coverage area and intended listening positions. The system commissioning certificate has been designed to help you note all the key parameters.

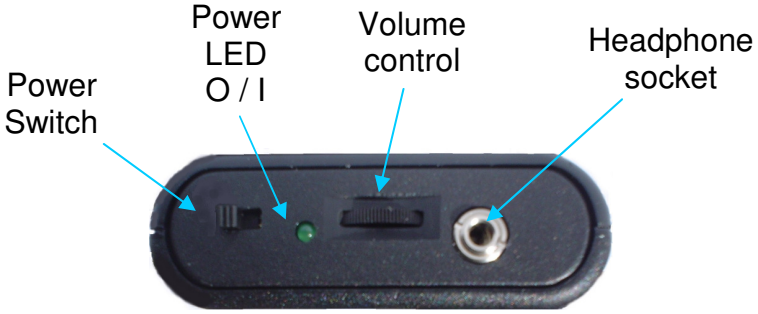
For detailed analysis of systems such as ultra low spill configurations, you may need more complex audio analysis tools such as an NTI Minilyzer used in conjunction with the CMR3 probe.

For further information on loop design principles see 'Designing Induction Loops' handbook (supplied) or contact Ampetronic for advice.

SCC – Signal Connection Cables

These procedures require connecting an audio source to the audio inputs of a loop system Ampetronic can provide a set of cables -SCC- to allow simple connection from most audio systems to most loop systems. Contact us for details or search at www.ampetronic.com.

OVERVIEW OF UNIT



Frequency Band Switch

Overload indication

Pick-up coil



Meter mode scales in dB relative to 0.4A/m

Field strength



Background noise



>+8

>-12

6	-14
5	-15
4	-16
3	-17
2	-18
1	-19
0	-20
-1	-21
-2	-22
-3	-23
-5	-25
-7	-27
-9	-29
-12	-32
-17	-37
-22	-42

Meter Mode Switch

Meter Mode Scales - See table on right for details


Frequency response



Absolute level is not important, only relative levels between frequency bands

OPERATION OF UNIT

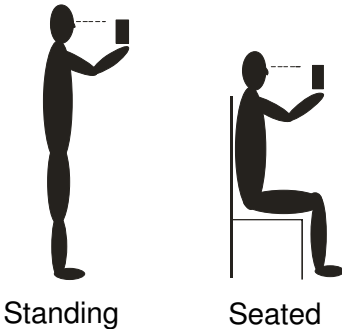
Batteries and power-up

 Remove battery cover the on back of the FSM. Unwrap and insert batteries into the unit ensuring correct polarity is observed. Replace battery cover.

Set the power switch to the ON (I) position and check the green power LED next to it is illuminated. Note: As the unit is switched on the front panel meter will briefly illuminate before settling to a measurement.

Method of use

For most applications it is the vertical component of the magnetic field that is received by the hearing aid, as a result the FSM is designed to be used while held vertically as shown:



Standing or seated depending on system use.

Typically:




1.2m for seated persons

1.7m for standing adults

Beyond this there is a range of use that must be considered - see **Test commissioning procedure** part 1 'Volume of use' for further details.

Mode selection

All modes measure Audio frequency magnetic fields using the internal pickup coil

Meter Mode	Reference	Filtering	Signal
 Frequency response	Compare levels between bands	1/3 Octave bands of 100Hz, 1kHz & 5kHz	Pink noise
 Field strength	0dB or 400mA/m	Flat 50Hz to 8kHz	Any
 Background noise	-20dB or 40mA/m	A-weighted	System off

Frequency Selection

Switch between one of the three 1/3 octave band filters when in Frequency response mode. While running pink noise, use the 1dB increment range of the scale to see how the 100Hz, and 5kHz levels compare with 1kHz.

Headphones and volume adjustment

Insert the headphones into the socket on the top panel of the unit, and adjust the volume using the adjacent thumbwheel.

For maximum flexibility, the signal heard in the headphones is post filter. This provides re-assurance that the correct measurement is being made, and can help with diagnosis of any problems.

Note: Headphones will be muted when $>+8\text{dB}$ / $>-12\text{dB}$ LED illuminates.

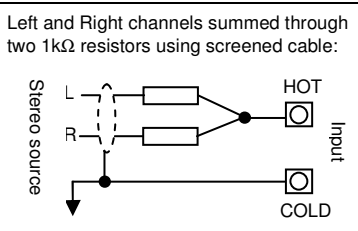
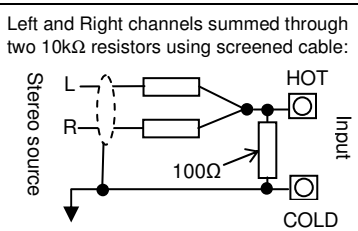
SIGNAL CABLES

In order to test / commission an induction loop system using the CD provided you will need to interface a CD player to an appropriate input of the system.

Most portable CD players will have a headphone output which can be used, and other equipment is likely to have a pair of phono outputs. Either way, care must be taken when feeding into a mono (single channel) input that both left and right stereo signals are summed / scaled correctly using appropriate resistors. The table below should provide a solution to the majority of inputs, but if in doubt contact Ampetronic for advice at support@ampetronic.com

These connections can be made using Ampetronic SCC (Signal Connection Cables) a kit of cables facilitating connection of most audio systems to most induction loop systems. Please contact Ampetronic or consult www.ampetronic.com for details.

Input type	Connector, pins & wiring		Connection requirements
Electret microphone i/p	2-pole jack	Tip Sleeve	Hot Cold
Balanced microphone i/p (phantom power off)	XLR	X pin 1 L pin 2	Cold Hot
		R pin 3	Cold
Unbalanced line level i/p (mono)	2-pole jack	Tip Sleeve	Hot Cold
Balanced line level i/p (mono)	3-pole jack	Tip Ring Sleeve	Hot Cold Cold
Low Z speaker i/p	Bare wire termination	Polarity is not important for floating inputs.	
Unbalanced line level i/p (stereo)	Twin phono	Left and Right have a separate cable each.	
100V speaker i/p	N/A		A CD player cannot produce these levels, and the best solution is to feed into the speaker system itself.



Note: It is possible to test a system by connecting only one channel (left or right) of the CD to the equipment. This will not be a problem with the FSM test signals disk as both channels (Left and Right) are identical.

AFILS TEST AND COMMISSIONING PROCEDURE

This procedure is intended to be used in conjunction with an Ampetronic Certificate of Conformity for AFILS according to IEC60118-4

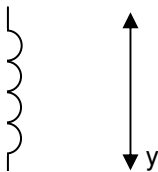
1 Volume of use (3 dimensions not sound level)

PURPOSE - define and record the three dimensional **useful magnetic field volume** for the loop system and determine a series of reference measurement points.

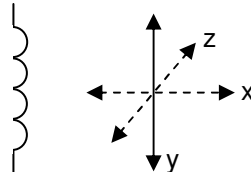
- Define the area of use and all required listening positions. Determine the height of use, i.e. the normal height of the hearing aid - typically 1.2m for seated persons, with a possible range of 1.0m to 1.4m. For standing adults a typical height of 1.7m, with a possible range of up to 2.0m and down to 1.0m for children or wheelchair users.
- Confirm the expected orientation of users hearing aid telecoils.

This is usually vertical, but in some environments where the user may be laying down the horizontal field strength may also need to be considered. All subsequent measurements using the FSM must take this into account.

The coil position inside the case, and orientation are indicated on the FSM by an inductor symbol as shown below:



The coil picks up signals parallel to the axis (y) of the symbol



Signals on other axes-----
(x and z) are not measured

- Sketch the **floor plan** and **useful magnetic field volume** on the Certificate of Conformity. Include any areas where overspill needs to be examined.
- Select 4 to 6 measurement points (e.g. A to F on the Certificate of Conformity) inside the loop where the system will be used. *These should be points that are representative of the whole volume of use. Experience will suggest where best to choose in order to get a good sample of the range of magnetic field strengths.*
- Consideration should be given to the use of the room and furniture layout. Some venues may have multiple room set-ups – e.g. movable seating / tables.

2 Background Noise

PURPOSE – check that the level of background magnetic noise is acceptable throughout the intended volume of use.

- Ensure the loop system is switched off, and all other building systems and services (e.g. lights) are operational.
- On the FSM: Select 'Background noise' mode.
- Locate and note maximum reading levels / positions on the Certificate ensuring the FSM pick-up coil is orientated the same as the hearing aid telecoils (usually vertical).



If a noisy zone is found a minimum of 30 sec should be taken to establish a maximum reading. Depending on the electrical environment and systems in use the noise may be transient in nature and an extended measurement period may be necessary (e.g. local electric transport services).

- Evaluate these levels against the following recommendations:
 - Below -42dB (off scale) is excellent performance for any installation.
 - Report levels greater than -32dB. Above this level the interference may be a problem for hearing-aid users. The character of the noise needs to be assessed before a loop system can be commissioned or ideally before is even installed.
 - Report and investigate levels greater than -22dB: This is an unacceptable level and remedial action will be required to provide coverage in this area.
- Outline and shade any problematic areas on the floor plan sketch of the Certificate of Conformity.
- The **useful magnetic field volume** can be reduced if background noise can not be controlled sufficiently in particular areas. If coverage of only a small number of seats is considered to be unacceptable, then an investigation of the noise source, and possible remedial action may be required.

3 Field Strength (set-up)

PURPOSE – set the field strength to approximately the right operational level



- On the FSM: Select 'Field strength' mode.
- Turn on loop system and set output current to zero (or low) to avoid sudden unexpected signal affecting hearing aid users in the vicinity. Run the combination noise test signal (CD track 1) into the loop system. Ensure any equalisation or filtering on the CD player such as 'Bass boost' is disabled.
- Increase the input gain to achieve compression (6dB / 12dB LED on the loop driver front panel for Ampetronic amplifiers).
- Select a typical listening position, and increase drive current until FSM reads approximately 0dB during the bursts of 1kHz sine wave. The reading is the *maximum* LED illuminated over 60 seconds. Ensure the pick up coil is orientated the same as the hearing aid telecoil – usually vertical.
- Take and note a series of readings at each defined measurement point (A-F), marking the positions and measured levels on a copy of the certificate ('initial' values).
- Adjust drive current such that in the ***useful magnetic field volume***:
 - Maximum reading is no greater than +3dB
 - 0dB is achieved somewhere
 - Minimum reading is no less than -3dB
- Record the 'final' levels on the certificate at each measurement position.
- Alternative method:
 - This test can also be performed using the 'Pink noise' signal (CD track 2). With this signal the peak readings must be between -9dB and -3dB, with at least one point in the volume reading -6dB. *Note: This method is more likely to be affected by any subsequent adjustments of the 'Tone' or 'MLC' control, and different amplifiers AGC / compressor characteristics.*
- Not advised:
 - Artificial / simulated signals such as ITU speech are not recommended as test signals for setting up systems - it is better to use the real thing, and then only as a final check.

4 Frequency Response

PURPOSE – check the frequency response is acceptable and adjust if necessary



- On the FSM: Select 'Frequency response' mode.
- Use pink noise (CD track 2) as an input to the loop system.
- At each measurement position (A-F), measure the readings with the frequency filter set to 100Hz, 1kHz and 5kHz – record the readings as 'initial' values on the Certificate of Conformity.
 - The reading is the *peak* reading on the LED display
 - Readings at 100Hz and 5kHz should be within $\pm 3\text{dB}$ of the reading at 1kHz
 - If required, adjust the tone or Metal Loss Compensation (MLC) of the amplifier to boost high frequencies and achieve $\pm 3\text{dB}$ across the three frequency bands.
- When all points achieve $\pm 3\text{dB}$ across the three frequency bands, record the three readings at 100Hz, 1kHz and 5kHz at each measurement point and record them as 'final' readings on the Certificate of Conformity.
- If it is not possible to achieve the required $\pm 3\text{dB}$ across the 3 bands, contact Ampetronic to discuss your application.

Note – Due to the nature of the noise signal, and the method of testing the 100Hz measurement can be erratic. If the reading is unstable, record the *peak* reading.

5 Field strength (confirm)

PURPOSE – make a final check, and readjust the field strength if necessary. Not required if there has been no adjustment in step 4.



- On the FSM: Select 'Field strength' mode.
- Select Combination signal (CD track 1).
- Re-test the system at one or more measurement points. Re-adjust if necessary to ensure the levels match the 'final' levels observed in step 3 and record these values on the Certificate of Conformity. Ensure the pick up coil is orientated the same as the hearing aid telecoil – usually vertical.
- Alternative methods:
 - This test can also be performed using the 'Pink noise' signal (CD track 2). With this signal the peak readings must be between -9dB and -3dB, with at least one point in the volume reading -6dB. *Note: This method is more likely to be affected by different amplifiers AGC / compressor characteristics.*
 - 1kHz sine-wave (CD track 3) can also be used for a short duration, however use of this signal for long periods can cause amplifiers to overheat. With this signal the peak readings must be between -3dB and +3dB, with at least one point in the volume reading 0dB.
- Not advised:
 - Artificial / simulated signals such as ITU speech are not recommended as test signals for setting up systems - it is better to use the real thing, and then only as a final check.

6 Overspill

PURPOSE – check that no magnetic spill exists that could interfere with a neighbouring loop system, above, below or to the side of this system, or cause a potential breach of confidentiality. This step is only required if there are neighbouring systems (within 4 x loop width distance) or there are confidentiality requirements.

*If **Overspill** analysis is not required - Go to step 7 **System use**.*

- Determine areas in which the spill of the system needs to be controlled – either for compatible operation with another system, or for confidentiality. Define points for measurement outside the room and mark them on the system sketch on the Certificate of Conformity (e.g. points G-K).

Note: Detailed architects drawings may be required in order to define the measuring positions for spill.



- Survey background noise in these positions with all loop systems turned off. This needs to be done to ensure that the spill measurements are not influenced by other factors.
- Switch on loop system, and using the combination signal (CD track 1) take a reading at each of the overspill measurement points (G-K). Ensure areas in which spill needs to be controlled read less than -40dB during the burst of the sine-wave signal. Ensure the pick up coil is orientated the same as the hearing aid telecoil – usually vertical.
- Alternative method:



- This test can also be performed in the frequency response mode (set to 1kHz), using the combination signal. The measurements should be taken outside the loop in the area where spill needs to be controlled - during the sine bursts.

This method does provide better rejection of the background noise signal due to the sharp filtering in this mode, but unfortunately the levels shown by the meter do not tally with either scale.

In this mode the central green 0dB (-20dB) reference LED will illuminate with a -15dB signal re: 400mA/m; i.e. to take a measurement deduct 15dB from the white scale (Field strength mode) reading.

- For more detailed analysis of spill and noise issues, the use of more comprehensive audio test kit may well be required such as an NTI Minilyzer and Ampetronic CMR3 probe.

7 System use

PURPOSE – check that the system is delivering a useable, undistorted comfortable sound when received through a hearing aid or listening device.

- Set up the loop system inputs as they will be used, with actual input devices and actual programme signal from the venue e.g. audio feed from PA, or microphone. System problems such as hum or HF oscillation warrant a full investigation – see **TROUBLESHOOTING**.
- Ensure the programme signal activates the compression on the loop driver. If not, adjust input gain until compression is achieved.
- Use the FSM in 'Field strength' mode to check the room for levels, and signal quality. Ensure the pick up coil is orientated the same as the hearing aid telecoil – usually vertical.
- Record levels at each measurement point. The reading is the *maximum* LED illuminated over a 60 second period. Readings should be between -9dB and 0dB throughout the volume depending on programme material, and field pattern. It should not be necessary to make any adjustment to the system for this test.
- Ideally, hearing aid users should be present to listen to the system. Care must be taken to ensure that the hearing aids are set correctly for telecoil use. Alternatively a loop listener can be used (such as the headphone output of the FSM, or the Ampetronic ILR3). The system should be observed for signal strength, intelligibility, distortion and overall quality.

It can be useful to mark the FSM thumbwheel in a position where a comfortable listening level is achieved with a given set of headphones. This provides an objective reference when evaluating systems and background noise characteristics.



TROUBLESHOOTING

POWER LED not illuminated

Check that the power switch is toggled to the ON (I) position.



Check the batteries are inserted the right way round.

Try new batteries – the LED is designed to be extinguished when batteries are low, and the unit is then un-calibrated.

No Headphone signal

Check the FSM switched ON

Check the headphones are plugged in, and the volume control is turned up.

Check the $>+8\text{dB}$ / $>-12\text{dB}$ LED is not illuminated – the headphones are automatically disabled when this LED is illuminated to protect the user.

$>+8\text{dB}$ / $>-12\text{dB}$, and $+6\text{dB}$ / -14dB LED is illuminated

The last red $>+8\text{dB}$ / -12dB LED indicates that the maximum level of signal in the respective mode has been achieved. Normal testing should not illuminate this LED; it should be seen as an overload condition.

Main LED meter is not illuminated.

Switch the unit OFF, and ON again. On power-up the meter should briefly light a few LEDs. If there is no audio frequency magnetic field present when switched on, there will be no meter LEDs illuminated.

Check AFILS is switched on and running current into the loop.

Check the power LED is illuminated

Low magnetic field strength

Check the loop system is running current.

Due to insufficient CURRENT or excessive metal loss. The application may require a special loop design to achieve acceptable performance, contact Ampetronic for advice.

AFILS loop driver not running current

Check the COMPRESSION LEDs are illuminating.

Check that the CURRENT control is turned up sufficiently.

Check that the LOOP ERROR, or OVERHEAT LEDs are not illuminated.

Switch the unit off and turn back on.

Consult the loop driver's installation handbook.

Background noise

Check all loop systems are switched off / not running any current.

If the interference is still present with the loop system switched off, then you need to locate and eliminate the source of the interference before switching the loop system back on. Monitor with headphones whilst switching other electrical systems such as power, lighting etc ON and OFF

Interference in other systems

Magnetic fields can induce currents into any low impedance electrical path or loop. Audio or video systems with poorly designed or multiple earths may experience pick up of the loop signal.

The loop signal may appear as jagged lines or hum bars on a CCTV picture. This may be due to the CCTV (low impedance unbalanced 2-wire circuit) cables running in close proximity to the loop cable.

Remote (and apparently unconnected) PA systems can sometimes pick up loop signals. Always run long audio signal cables as 3-wire balanced circuits and keep away from loop cables. If in doubt, contact Ampetronic for advice.

TECHNICAL SPECIFICATIONS

POWER

Internal batteries	2 x AA / LR6 / AM-3
Range of operation	1.8V to 3.2V overall DC
Power	0.15W
Battery Life	Up to 100hrs depending on use, >40hrs typical

SIGNAL PROCESSING

<i>Meter Mode</i>	<i>Gain</i>	<i>Measurement scale</i>	<i>Frequency Response</i>
Frequency Response	0.071A/m (-15dB)	Measure difference between bands	1/3 Octave at 100Hz, 1kHz or 5kHz
Field Strength	0.400 A/m (0dB) as per IEC60118-4	-22dB to +8dB	Flat / unweighted 50Hz to 8kHz ± 0.25 dB
Background Noise	0.040 A/m (-20dB) reference	-42dB to -12dB	A-weighted

All measurement modes are true RMS 125ms detection. The FSM is defined as a Class 2, Type 2 meter according to IEC60118-4 and IEC61672-1 (where relevant). Overall gain change <0.5dB

OUTPUTS

Headphone socket	3.5mm stereo jack connector. 16 Ω min (32 Ω per side - outputs parallel) Maximum cable length 3m
Meter display	Colour coded flying spot LED
Power LED	Indicates unit is ON and calibrated

PHYSICAL

Weight	150 g (excluding batteries)
Dimensions	84 x 140 x 27 mm

ENVIRONMENTAL

Ingress Protection	IP20
Operating temperature range	-10 to 45°C
Relative humidity	10 to 85% Non condensing

ACCESSORIES

SCC - Signal Connection Cables – A kit of cables for interfacing audio sources to inputs of induction loop systems

Details of all products and services provided by Ampetronic can be found at our website: www.ampetronic.com

WARRANTY & CALIBRATION

This product carries a five year parts and labour warranty from date of shipment from Ampetronic. To qualify for the five year warranty, the product must be registered at www.ampetronic.com (products/warranty), without which the warranty will be valid for two years only. The warranty could be invalidated if the instructions in this handbook are not followed correctly, or if the unit is misused in any way.

The FSM is calibrated during manufacturing test, and is valid until one year from the date the equipment leaves Ampetronic. Initial re-calibration is recommended one year from this date. This period may be extended if no adjustments are necessary.

DECLARATION OF CONFORMITY

Manufacturer: Ampetronic Ltd.

Northern Road,
Newark,
Nottinghamshire.
NG24 2ET.
United Kingdom.

Declares that the product:

Description: Field Strength Meter
Type name: FSM



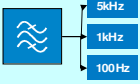



Conforms to the following Directive(s) and Norm(s):

Directive 2004/108/EC
EMC: EN55103-1 : 2009 Emission
EN55103-2 : 2009 Immunity

Directive 2006/95/EC
Safety: EN60065 : 2002

Date: January 2011
J.R. Pieters
Managing Director
Ampetronic Ltd.

BASIC COMMISSIONING PROCEDURE

AFILS Commissioning Procedure for Ampetronic FSM to IEC 60118-4:2006					
Step	Audio input	FSM settings	Adjustments	Performance requirements	
1	Volume of use	SYSTEM OFF	METER OFF	n/a	Determine volume of use Sketch Layout
2	Background Noise	SYSTEM OFF		Sources of magnetic noise	< 22dB essential < 32dB acceptable
3	Field Strength (1)	Track 1: COMBINATION *		Loop current	-3 to +3dB peaks
4	Frequency Response	Track 2: PINK NOISE		MLC / tone control	-3 to +3dB peaks compared to 1kHz
5	Field Strength (2)	Track 1: COMBINATION *		Loop current	-3 to +3dB peaks
6	Overspill (if required)	Track 1: COMBINATION		n/a	< 42dB (OFF SCALE)
7	System use	ACTUAL SIGNALS		Input gain	-9 to 0dB peaks Subjective -> OK

* Other signals may be used with revised performance requirements: PINK NOISE -9 to -3dB, 1kHz SINE -3 to +3dB

TEST CD TRACK LISTING

Track 1: COMBINATION (30 mins) Pink noise with 1s bursts of 1kHz Sine

Track 2: PINK NOISE (30 mins) Bandlimited as per IEC60118-4

Track 3: 1kHz SINE (1 min)

Contact information

Website: www.ampetronic.com

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