

# PHILIPS SPEECH SECURITY

MASC III encrypted radio



# PHILIPS

# The unwelcome listener

*- an increasing risk*

Late at night, a stolen car smashes through the window of a photographic store. While two of the criminals begin loading expensive cameras into the car, the driver monitors police radio messages on his portable UHF radio. The car speeds away just before the police arrive . . .

A surveillance team has tracked a consignment of illegal narcotics across Europe over several days. When they make their interception, they find the gang waiting to greet them with knives and chains . . .

Today, anyone from the professional criminal to the teenage radio enthusiast can buy cheap, sophisticated frequency-scanning radio equipment off the shelf. They need very little knowledge to find your mobile radio channels and listen to everything that is said.



## Secure voice communication reduces the risk in:

- **Police operations**
- **VIP protection**
- **Port and airport security**
- **Surveillance**
- **Customs investigations**
- **Private security services**

*. . . and many more areas where public access to your voice messages can jeopardise your operations, threaten the safety of your staff or reveal sensitive information to your competitors.*



**The only effective solution is to add the security of speech encryption to your communications, so anything the unwelcome listener hears is completely unintelligible.**

*"The officers on the streets don't care about new communications control rooms. What they want is secure radios, and they want them now!"*  
*City police communications officer*

### Cost-effective security

Philips has been supplying radio systems worldwide for fifty years. We have unique experience of the technology of secure radio, and of the practical details of setting up end-to-end secure systems.

The most cost-effective way to achieve secure speech communication is to add encryption to your existing analogue radio system. We make it easy for you by supplying the complete solution, from design through to commissioning. We are the only manufacturer capable of providing complete MASC encryption systems. And our solutions provide a higher level of security than most competing solutions, thus reducing your risk.

### Philips MASC III encryption

Conventional encryption systems use coding techniques which are not secure enough to defeat today's criminals. The system we recommend, MASC III, was developed in the UK by GEC-Marconi. Its encryption is highly resistant to even the most determined unauthorised listener.

#### The major advantages of Philips MASC III analogue radio solutions are:

- They are cost-effective and reliable
- They provide a high level of security
- Speech quality is good
- MASC encryption is well proven by demanding users
- MASC operates well on standard analogue radio systems



### Complete, end-to-end solution

Philips is the only manufacturer to offer end-to-end, high-quality analogue speech encryption solutions.

We design your system, manufacture the equipment, install and commission it, and make sure your users are fully trained to gain the maximum benefit from secure communications.

- Defining your needs
- Radio propagation studies
- System design
- Project management
- Installation and commissioning
- User training
- Support and maintenance



*The UK Association of Chief Police Officers, ACPO, has recommended the MASC III device as the standard for fitting to existing police radio schemes to provide speech privacy.*

*MASC III is the only device recommended for this purpose.*

**MASC**

Registered trademark of  
GEC-MARCONI SECURE  
SYSTEMS LTD.

# Philips MASC III

*- the complete solution*

**Philips MASC III radio systems provide secure communication on analogue radio, for any size of system from a single site to a regional network. They are engineered to the highest standards, and use the latest digital signal processing technology for flexibility and reliability.**

**We can supply an entire system, including all transmission, control and terminal equipment or (in most cases) we can add MASC III encryption to your existing system.**

## Typical quasi-synchronous MASC III system

### Well-engineered radio system

- encryption requires good radio coverage

### Control system

- with links to other communication systems

### Base station

- one or more, depending on the coverage area

### MASC III encryption control unit

- fitted with a MASC channel card for each encrypted channel

### Hand terminals and mobile radios

- fitted with MASC III coder/decoder

### Call logging system (optional)

- provides valuable communications traffic management features

## Features of a Philips MASC III system

**Philips MASC III systems include a number of features which offer important advantages in use.**

### Excellent security

The encryption code cycle is up to 50 times longer than in many similar systems, and is therefore very much more difficult to break into. Each radio can hold a number of keys, so that each user group can use a different code setting. We will advise on methods to maintain high security.

### Reliable communication

System-wide synchronisation allows any radio using the current code key to receive an encrypted message. For maximum reliability, a synchronisation signal at the start of a message is followed by further signals at intervals to maintain synchronisation and allow late entry of other authorised users.

### Secure inhibit

Philips MASC III radios are fitted with a 'secure inhibit' which prevents transmission during reception of a secure transmission, to prevent interference between two encrypted transmissions.

### Priority alarms

Radios can include an 'alarm' function which transmits a priority alarm call to the control room in emergency situations. The alarm can also open a transmission channel so the caller can be sure of instant communication.

### Radio disable

If a radio is lost or stolen, it can be disabled over the air by a signal from the control room. Philips PRP74 hand portable radio also includes a 'beacon' mode in which the radio is disabled but continues to transmit a tracing signal at intervals.

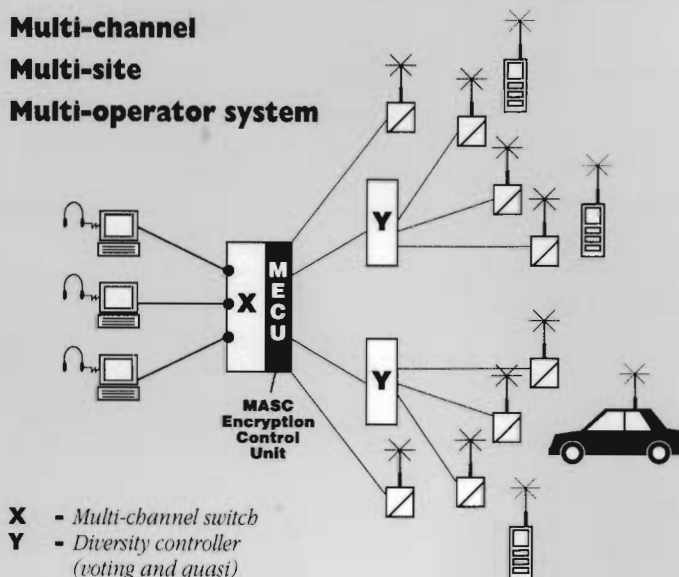
### Clear mode

The system can be switched at any time to clear (non-encrypted) speech - although users normally choose to remain permanently in secure mode.

### Multiple key groups

Philips portable radios can store up to three groups of encryption 'traffic keys', enabling them to be used in more than one region or system.

## Multi-channel Multi-site Multi-operator system





A police control room dispatcher using the MASC encryption system.

Call logger presenting the dispatcher with an instant view of the most recent transactions on the channel.



Modular construction of Philips MASC encryption unit PRS3040 designed for a variety of new and existing control systems from Philips.

## MASC III security

The very high security of MASC III encryption

derives from three elements:

### Voice processor

The speech signals are made unintelligible by a complex digital process called dynamic spectral rotation. The degree, speed and direction of this 'rotation' depend upon a number received from the 'keystream generator'. This number is changed more than ten times every second, making analysis of the signal extremely difficult.

### Keystream generator

The MASC III keystream generator produces a rapid sequence of numbers. This sequence is itself determined by two variables: a 'traffic key' selected by the user and a 'message key' selected at random by MASC III for each message. The keys are set up automatically in the synchronisation process at the start of a transmission, and a receiving radio will only be able to decode the message if it is programmed with the correct numbers to interpret the keys. Keys can be re-programmed as often as required, to ensure continuing security.

### Traffic key

Each traffic key is a 38-bit number, which means there are more than 10<sup>11</sup> (or 100,000,000,000) different numbers to choose from. This stops two MASC III users independently choosing the same key - and prevents a hostile listener from being able to find the particular number in use.

MASC keyfill gun - simple and rugged.



Philips range of mobiles with MASC encryption.

The rugged, water-resistant and multi-channel PRP74 portable radio is unique in having MASC III fitted as standard.



# A practical system

*- for operational reliability*

**Philips MASC III secure radio systems are designed to work reliably in your normal operating conditions. The only significant effect for your users is the very welcome addition of total security to their communications.**

Single/two channel MASC control unit for simple systems.



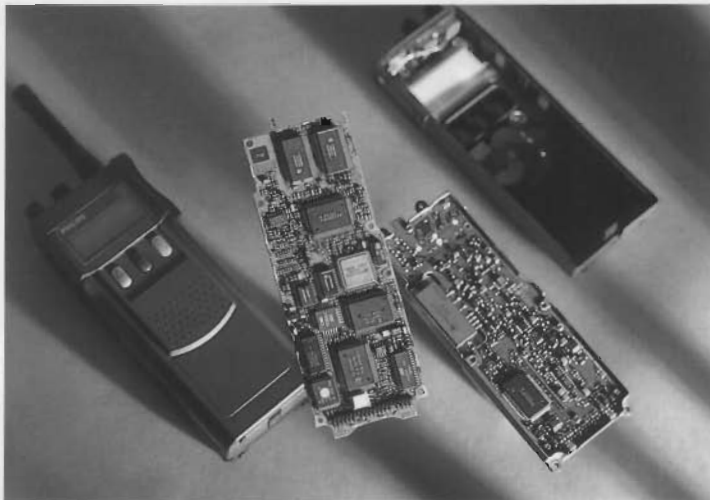
## Speech quality

The speech quality recovered from a MASC III encrypted message is very close to that of a clear speech system.

## Existing functions are retained

MASC III has no effect on the performance of your radio equipment or the functions provided. System control frequencies, outside the normal audio band, will continue to operate as before.

Full integration - Philips is the only manufacturer with fully integrated MASC encryption in its equipment.



## Operation in low signal strength

Powerful coding and error-correction techniques enable MASC III to maintain its encryption synchronisation in the variable signal strengths of normal operation.

## Operation in fade conditions

In very poor signal conditions, MASC III's synchronisation will be maintained for up to nine seconds by a 'flywheel' technique.

## Squelch rise time and base station keying

MASC III includes the facility to programme the time for establishing a link, to suit the characteristics of the existing system.

## Compatibility with public telephone network

MASC III is compatible with standard public switched telephone network (PSTN) lines, both analogue and digital.



# Support and services

*- the essential factor*

**The support and services Philips provide are crucially important in ensuring a smooth transition to the full benefits of secure communications.**

## **Radio engineering**

Philips specialist radio engineers will examine your existing system, and if necessary adjust or modify it to ensure that it provides the performance you need for secure communication. In particular, we will check that:

- **The signal level is adequate across the coverage area**
- **Landline or microwave link quality is good**
- **Base stations are operating correctly**



## **User training and support**

The techniques for using encrypted radio are essentially the same as for conventional analogue radio. However, it is important that users understand the practical requirements of secure speech. Both operational and control room staff will need training in the proper use of the equipment, and support during the initial stages.



## **Partners at your service**

**Philips have an outstanding reputation for service. As a customer, you benefit from our specialist expertise in mobile radio at every stage of your project:**

- **Defining your needs**
- **Radio propagation studies**
- **System design**
- **Project management**
- **Installation and commissioning**
- **User training**
- **Support and maintenance**



*Only Philips can provide the end-to-end service you need for a smooth transition to secure communications.*

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**DON'T GIVE IT THEM ON A PLATE!**



**THE FREE LUNCH IS OVER.**  
With MASC Radio Systems Security

**GEC-Marconi**  
Secure Systems



# The threat is too important to ignore...

Radio communications are, by their very nature, an open medium. Anyone could be listening in to everything you say with cheap, easy-to-use frequency scanning equipment.

## The threat is too important to ignore.

Scanners that can intercept and receive radio signals are readily available through high street stores.

Consider the implications for:

- Confidentiality
- Personal Safety
- Operational Success

## Stop giving sensitive information away.

Eavesdroppers are becoming increasingly sophisticated. Determined criminals are often able to defeat conventional scrambler systems.

MASC is the latest generation voice security system from GEC-Marconi, world leaders in the design of secure communications equipment for military and intelligence applications.

## MASC is the high security solution.



### MASC provides:

- Total security
- A complete system solution
- Exceptional voice quality

**Don't be fooled into buying low grade systems.**

**The eavesdropper is already one step ahead.**

**MASC guarantees total security.**

MASC provides the highest level of long term security for radio transmissions.

**Do you know who is receiving your radio transmissions?**



## The Highest Security:

- Advanced digital coding techniques
- High powered Digital Signal Processors
- Complete 'end to end' security
- Highly resistant to sophisticated methods of attack

Designed to provide long term security, MASC will not become outdated as the criminal world becomes increasingly sophisticated. MASC is highly resistant to determined attack and will reliably protect your radio communications from unauthorised access.

Developed for use in Public Safety situations, MASC offers the best of both worlds; security close to that of digital systems, together with cost effective integration into analogue systems.

MASC has been selected for use on UK Police radio systems and is proven in operational conditions on a wide variety of system types.

MASC provides the flexibility required to protect any type of radio system, large or small, through the provision of a wide range of equipment. Whatever your requirement MASC can provide the optimum solution to radio communications security.

**MASC is the Total Systems Solution.**



### The System Components

#### Mobile/Portable Radio

- DSPs
- Modules

#### Security Management

- Crypto Management Unit
- Fill Gun

#### Systems Equipment

- Housings
- Channel Card
- Control Card
- Voting Card
- Remote Control Panel

#### Network Management

- Call Logging System



*"MASC has effectively increased operational success both in terms of information security and personal safety"*



# MASC is the total system solution



## Compatible with many types of radio scheme:

- Conventional and trunked systems
- Quasi synchronous systems
- Multi Operator / Multi Channel
- All standard channel spacings
- CTCSS

## The System Solution:

- Equally suitable for small or large systems
- Adaptable to a wide variety of systems equipment
- Flexible methods of integration

## Systems Equipment

A complete range of systems equipment allows MASC to be integrated into a wide range of radio systems.

Solutions range from a desk top unit for one or two channels to multi-channel units, each catering for up to twelve channels.

The various systems cards and housings available provide a flexible building block approach to overlaying MASC onto a system.

## Network Management

The Call Logging System adds a further dimension to systems management and control.

A PC based system allows multiple channels to be logged and controlled. The ability to network the PCs provides the flexibility to cater for large scale multiple operator applications.

- Up to 16 PCs in a network
- Up to 24 channels in a network
- Each PC logs and controls up to 16 channels
- Stunring of radios
- Over the air control of radios (clear or any one of four secure modes)
- Display of radio alarm messages
- Statistical analysis of radio traffic

## MASC Bandwidth Requirements

MASC's programmable bandwidth allows the best to be made of the radio scheme while allowing MASC to operate within the bandwidth restrictions of complex systems. In addition, CTCSS compatability is always maintained.

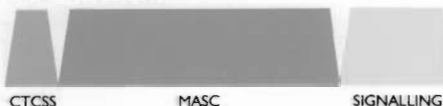
### Wide Bandwidth



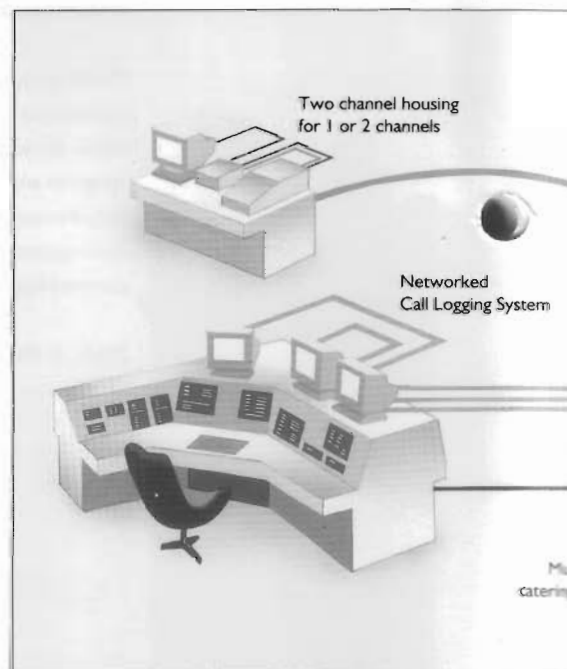
### Middle Bandwidth



### Narrow Bandwidth



## MASC integrates into a wide range of systems



# MASC is the cost effective solution

## Call Logging System

Time	Ch	Radio	Call sign	Number	Message type	Duration
11:11:45	S2:2	NOT S985	10903	2222	Secure	5 second(s)
11:11:54	S2:2	NOT S985	10903	2222	Secure	4 second(s)
11:11:51	S2:2	NOT S985	10903	2222	Secure	1 second(s)
11:11:50	S2:2	NOT S985	10903	2222	Secure	1 second(s)
11:11:49	S2:2	NOT S985	10903	2222	Secure	8 second(s)
11:11:36	S2:1				RADIO ALARM	
11:11:47	S2:1				Alarm received on channel S2 from radio NOT S985	
11:12:25	S2:1				In use by call sign All is number 2222	
11:13:32	S2:1				Type ESC to acknowledge alarm	
11:14:00	S2:1					
11:14:35	S2:1					
11:15:42	S2:2	NOT S985	AR 40	4657	Secure	9 second(s)
11:16:39	S2:2	NOT S985	C10 24	1504	Secure	4 second(s)
11:16:52	S2:1	NOT S985	C10 24	1524	Secure	3 second(s)
11:17:52	S2:1	NOT S985	AR 14	3291	Secure	4 second(s)
11:18:00	S2:1	NOT S985	AR 31	2312	Secure	1 second(s)
11:18:45	S2:2	NOT S985	AR 55	4421	Secure	2 second(s)
11:21:19	S2:1	NOT S985	C10 20	1976	Secure	4 second(s)

## Crypto Management System

Label	PROG	MODE
Current STANDARD FILL		
TRAFFIC KEYS		
Traffic Key 1 11-05-02-15-00		
Traffic Key 2 20-30-11-05-30		
Traffic Key 3 00-10-02-07-00		
Traffic Key 4 12-30-07-03-00		
AUTHENTICATION KEYS		
Authentication Key 00-00-31-00-70	SR1000 A-WT 6	
Authentication Key 27-00-1994		

## TRAFFIC MANAGEMENT

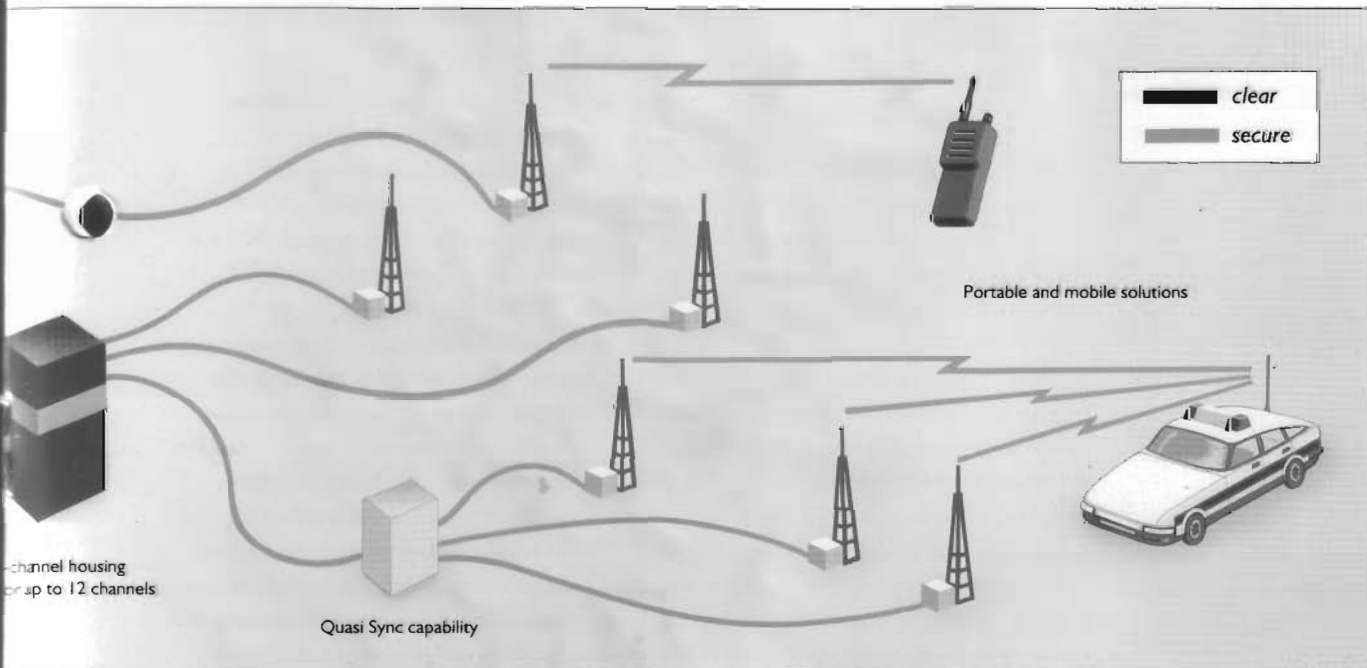
- Networked Call Logging
- Emergency Alarm
- Stunning of stolen radios
- Over the air control

## Mobile and Portable Installations

A range of security modules are available for incorporation into handheld and mobile radios including:

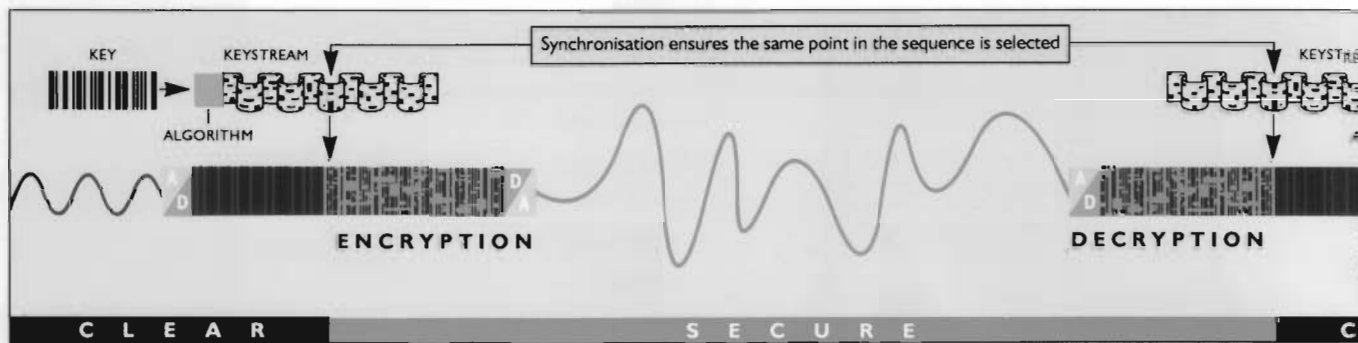
- Embedded solutions using Digital Signal Processors
- Radio specific retrofit kits
- General purpose boards with the flexibility to suit most requirements

MASC provides analogue systems with security close to that of digital systems.



# MASC is the high security solution

## Basic Encryption/Decryption



**Encryption is the term used to encompass a technique in which the voice signal is processed in an apparently random manner and rendered unintelligible before being transmitted.**

### Digital Processing

MASC converts speech to digital form before any processing of the signal for transmission.

Digital signal processing is one of the reasons for MASC's exceptional performance. Only after all the processing is complete is the signal converted back to analogue form for transmission. A similar process is used when receiving a secure signal.

### The Encryption Process

The apparent randomness of the transmitted signal is the key to its security. A random sequence of numbers is used to process the voice signal in an apparently random manner.

Randomness is achieved using a pseudo-random sequence of numbers known as the Keystream. The less predictable the sequence, the higher the security. The sequence is produced by a complex mathematical process known as the encryption algorithm. The exact process is determined by a long number loaded into the encryption module for the algorithm

to use. This number is called the "key".

The sequence produced is unique for each individual key. The quality of the algorithm (the randomness and length of the sequence produced) and the size of the key both affect the level of security. A radio receiving an encrypted signal must use the same algorithm and key to successfully decrypt it.

### Continuously Variable Dynamic Spectral Rotation

Numbers from the pseudo-random sequence/Keystream are used to determine the Continuously Variable Dynamic Spectral Rotation (CVDSR) processing of the speech signal. This is a technique unique to MASC.

Because this process involves many rotations per second using a large number of rotation points and a continuous and variable rate of rotation, a level of security not previously available on analogue systems is provided. Each call uses a new randomly selected set of numbers from the sequence. This considerably enhances the security of the system by ensuring that each transmission is encoded differently.



## MASC Advanced Encryption

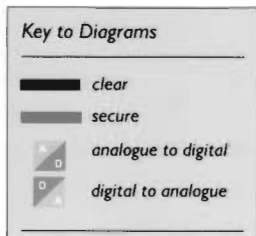
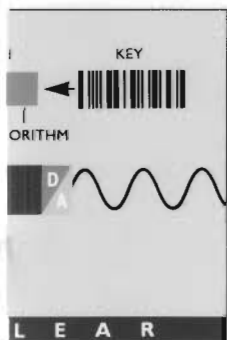


Diagram Left:  
Elementary Encryption System.

### Security Management

There are two main ways in which security can be compromised. Firstly the known loss of a radio: this can be dealt with using the Call Logging System to stun the radio. Secondly, the unknown loss of the key material: this is dealt with through periodic changes of the key.

MASC Security Management is provided by a PC based Crypto Management Unit (CMU) and a hand held Fill Gun.

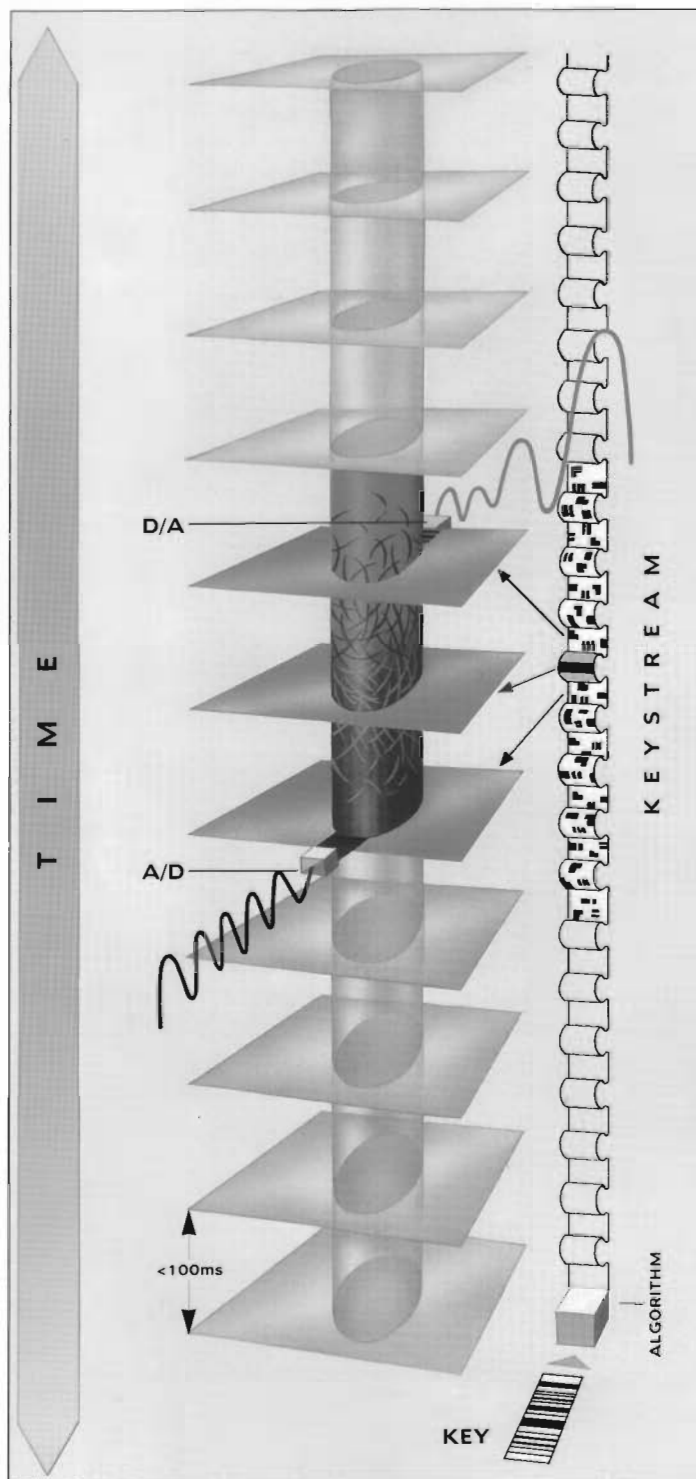


Diagram Right: MASC Encryption System  
incorporating Continuously Variable  
Dynamic Spectral Rotation (CVDSR)

More than 10 times every second one of the 30 million numbers in the Keystream is used to control the CVDSR process. Each of the 270,000 million possible keys produces a unique sequence of numbers in the Keystream.



# Technical Specification

## Coding Technique

Rotation rate	Continuously Variable Dynamic Spectral Rotation (CVDSR) using a proprietary encryption algorithm.
Sequence length	Greater than 10 times a second.
Delay time	Greater than 30 million. Less than 10ms.

## Keys

Traffic keys	4 encryption keys, each 38 bits (greater than 270,000 million combinations).
Authentication key	38 bits for validation of 'over the air' control messages. Spoofing protection also incorporated.

## Synchronisation

Initial synchronisation	Better than 99% at 10dB SINAD.
Initial synchronisation time	Less than 200ms, typically 450ms from PTT to receiving decrypted voice on a system.
Re-synchronisation	Better than 99% at 10dB SINAD (using data bursts of less than 30ms, blanked in receive audio).

## Features

Stunning	Radio is remotely disabled and the keys erased.
Polling	Checks the radio is within range and switched on.
'Over the air' control	Control of clear and secure mode using any one of the four keys.
Alarm	Transmission of an alarm burst for display on the call logging system.

## Standard Programmable Facilities

21 bit identity	Sent with every transmission (>2 million combinations).
32 bit password	Must be correct if the unit to be stunned (>4000 million combinations).
Link establishment time	300 to 3000 ms, in 15 steps.
Re-synchronisation interval	1.2 to 4 secs nominal, 4 options.
Bandwidth	400-2500 Hz to 340-3140 Hz, 3 options.
Clear override	Enable/disable reception of clear signals in secure mode.
Secure transmit inhibit	Enable/disable transmission when receiving secure signal.
Secure mode only operation	Enable/disable clear transmission.
Clear warning tone on receive	5 volume level options, including off.
Alarm transmission	Enable/disable.
Manual erasure of keys	Enable/disable.
Group delay compensation	Separate transmit & receive parameters (radio/system dependent).

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Secure Systems



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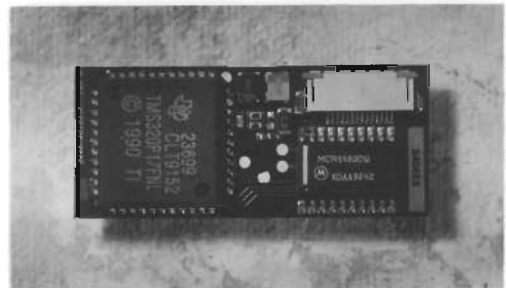
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# MOBILE AND PORTABLE PRODUCTS

A number of products are available which allow MASC to be incorporated into mobile and portable radio equipment. Many radio manufacturers/distributors are able to supply radios already fitted with MASC using one of the following solutions.

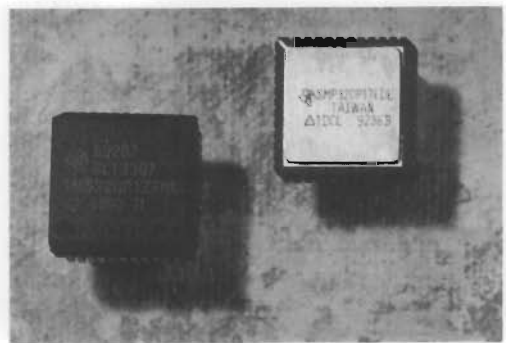
**VARIANT BOARD** - The variant board has the flexibility to allow MASC to be added to a wide range of radios including those where space is at a premium. Its small size together with adjustable interface levels simplifies installation into radios. All the standard MASC features are implemented. The user interface employs existing radio buttons and switches and allows manual changing between clear and secure mode together with encryption key selection.



**RETROFIT KITS** - Retrofit kits are available for both the Motorola HT600e radio and short frame Philips PFX radio. These kits include the MASC board and replacement radio front cover, wiring harness and hardware. Installation entails fitting the existing loudspeaker and microphone into the new front cover together with the MASC board, installing the wiring harness, testing and re-assembly.



**APPLICATION SPECIFIC DSPs** - Digital Signal Processor integrated circuits can be supplied programmed with MASC functionality. This enables radio manufacturers to integrate MASC into their products at the design/manufacture stage. Standard devices are available, alternatively host specific versions can be produced to customer requirements. This is the most cost effective means of integrating MASC into a radio.



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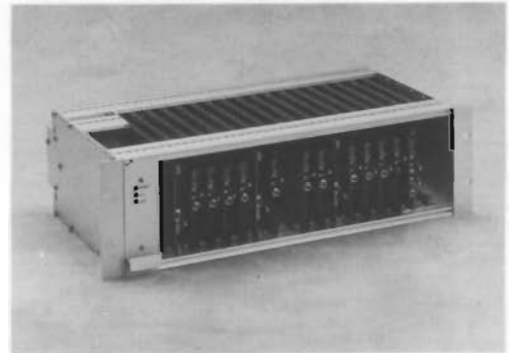
# SYSTEMS EQUIPMENT

Systems Equipment provides the basis for utilising MASC in small or large radio schemes. When fitted with the appropriate Systems Cards a complete solution to radio system security is provided.

**TWO CHANNEL HOUSING** - Designed for small systems, this unit allows desk-top implementation of MASC. Accommodating one or two channel cards and, optionally, a voting card gives the capability to operate up to two channels, or one channel with two channel receive voting. Front panel operator controls are provided while connection to the host system and the Call Logging System is via rear panel connectors. Mains or 12 volt operation is catered for.



**MULTI CHANNEL HOUSING** - This unit provides the housing for a larger number of systems cards (up to twelve Channel cards, three Voting cards and a Control card). This gives the capability to interface with up to twelve radio channels as well as providing for various system configuration options, including receive voting and local or remote control of a number of facilities. The housing consists of a standard 19 inch by 3U high card frame incorporating backplane, systems connectors and mains power supply.



**REMOTE CONTROL SWITCH PANEL** - Each panel allows up to twelve channels to be remotely controlled between clear and secure operation from the dispatcher's position. The switch panels may be daisy chained to provide up to thirteen operator positions. The panels are for use with a multi-channel housing based system.



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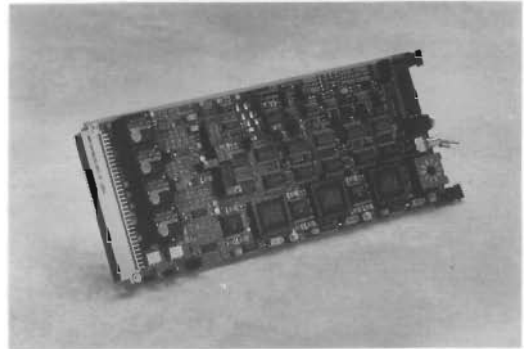


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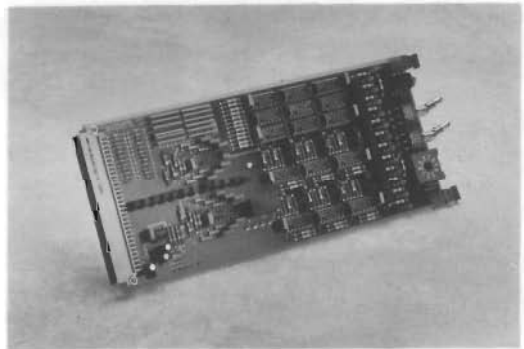
# SYSTEMS CARDS

The System Cards are for use with the MASC Systems Equipment. Together they provide all that is required to meet most radio scheme applications.

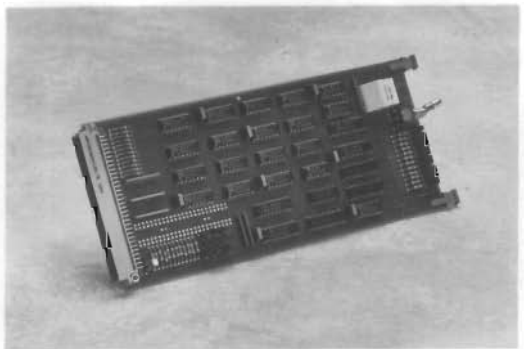
**CHANNEL CARD** - The channel card forms the core of the MASC system. When interfaced to a radio channel the card provides clear and secure transmission and reception. An interface for the Call Logging System is also provided. The system interface is versatile enough to suit nearly all installations. Manual clear/secure control is provided on the card. Alternatively remote control may be implemented by use of the Call Logging System or the Remote Switch Panels (via the Control Card, see below). Channel cards may be installed in both the Two channel and Multi-Channel housings.



**CONTROL CARD** - Recommended for use in a multi-channel housing, the control card provides manual control of all 12 channel cards simultaneously as well as the ability to programme (or fill) all Channel cards simultaneously. In addition, the facility to connect remote control switch panels is provided.



**VOTING CARD** - Voting cards may be fitted to systems to allow receive voting on up to five channels. Bit error rate techniques are used to determine the best channel. Both the Two Channel and Multi-Channel housings accept Voting cards.



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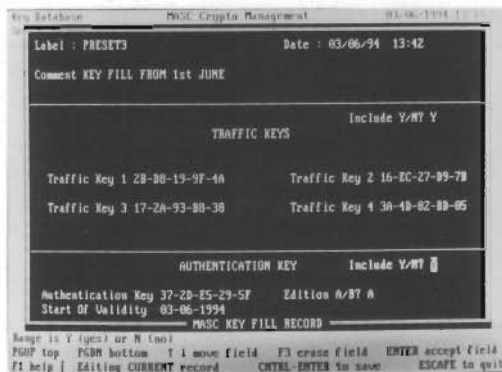


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# SECURITY AND NETWORK MANAGEMENT

Security management is essential to any secure system. The elements required are provided by the products listed below. The Call Logging System also brings the additional benefit of network and traffic management to MASC radio systems.

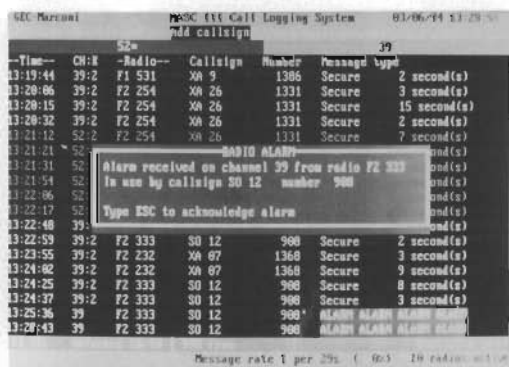
**CRYPTO MANAGEMENT UNIT** - The Crypto Management Unit (CMU) software package runs on a standard PC. The CMU allows the user to generate encryption keys and configuration data for loading into MASC equipments. Programming may be carried out directly from the CMU PC or via a portable Fill Gun. A windows style presentation is used and a comprehensive help facility provided. Password protection and encryption of data provide security against unauthorised access.



**FILL GUN** - The Fill Gun accepts 'fills' (encryption keys and/or configuration data) from the Crypto Management Unit which can then be downloaded into MASC. This portable, rugged, hand-held unit enables easy distribution of the 'fills' to MASC equipments. A display with a user-friendly menu system and keypad make operation very simple. Password protection and tamper proofing add to the security of the unit.



**CALL LOGGING SYSTEM** - The Call Logging system software package provides numerous facilities for radio traffic network management. When installed on a PC it may be interfaced with up to twenty four MASC channels. The user interface is via pull down menus with context sensitive help provided. Holding a database of the radios on the system enables all received calls to be logged by call sign, radio identity and user number. The channel on which the call was received is also indicated. Additionally, radio alarm messages are displayed. Radios can also be stunned if lost or polled to check they are still active. As well as controlling the mode of the channel (clear or secure in any one of the four keys) the operator is able, by 'over the air' commands, to control the mode of the radios in the field. Up to sixteen PCs may be networked together for a multiple operator system, each PC being configured to log/control up to sixteen of the channels to which the network is connected.



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