Radio alarms in the mobile radio environment

G. R. Moore

Summary This article describes a new addition to the range of equipments supplied by Marconi Mobile Radio in the field of alarm systems. It illustrates the use of selective calling methods to enable the detection via a radio bearer of alarm states at a remote location. This would allow, for example, the detection at a remote water pumping station of such parameters as high well levels, pump failures or mains failure. These states can then be displayed at the system control for interpretation so that the required action can be taken. Also described are the RC1307 Alarm Unit, the RC1700 Radio Modem and their associated systems.

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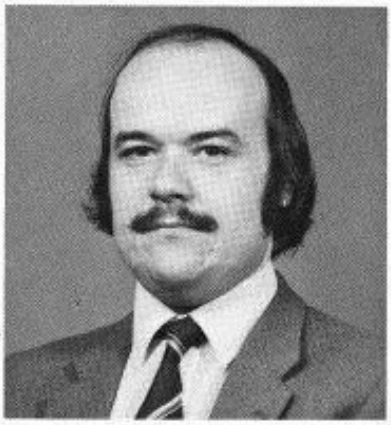

Introduction

Over the last few years much interest has been shown in the signalling of alarm states from a remote site over a radio bearer. The reasons for the upsurge in such systems may be ascribed to:

a) many of the public utilities which already possess a v.h.f radio system may be reluctant to finance a completely new radio telemetry scheme when a data signalling overlay on their present system would perform adequately,

b) as most mobile radio systems installed in the last few years utilize some kind of selective calling (selcall), a scheme based on this form of signalling can be a cheaper and more readily available alternative,

c) a selcall-based system would use many components of the standard radio system already possessed by the customer, thus simplifying maintenance and spares holding.

Awareness of the lack of suitable off-the-shelf equipment to perform the required alarm functions has led Marconi Mobile Radio to develop an alarm system based on the RC1307 Intelligent Alarm unit (figure 1).

The initial requirement was for the remote monitoring of up to eight alarm states at remote sewage pumping stations. The parameters to be monitored included mains failure, pump failure and high well levels as well as several functions particular to each site.

These alarms were to be signalled back to control over the normal radio channel where they were to be interpreted and displayed as a message in plain English.

General description of the RC1307

This is a microprocessor-controlled selcall encoder/decoder which, when activated by an input from an external alarm sensor, transmits the alarm data as audio tones via a standard v.h.f transceiver. The high-impedance buffered input lines to the unit can be

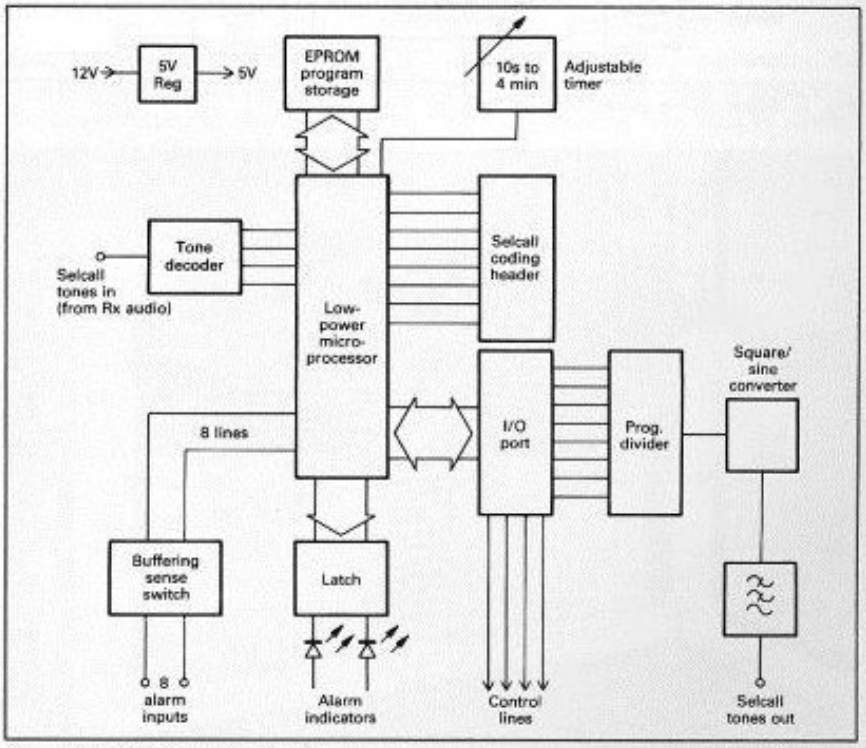

Fig. 1. RC1307 block diagram

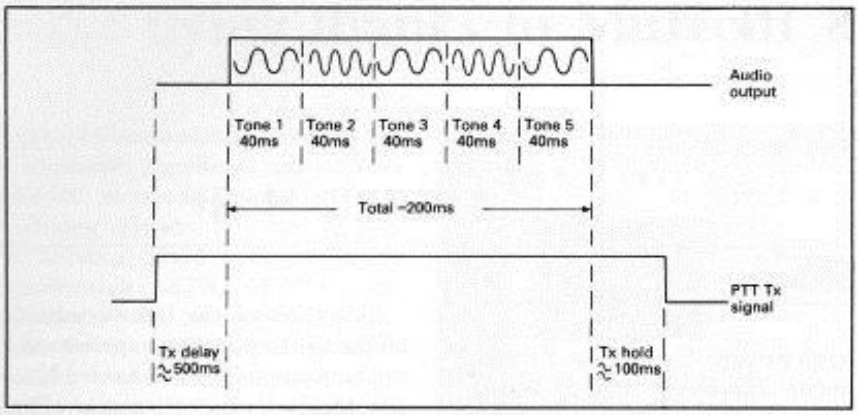

Fig. 2. Selcall format

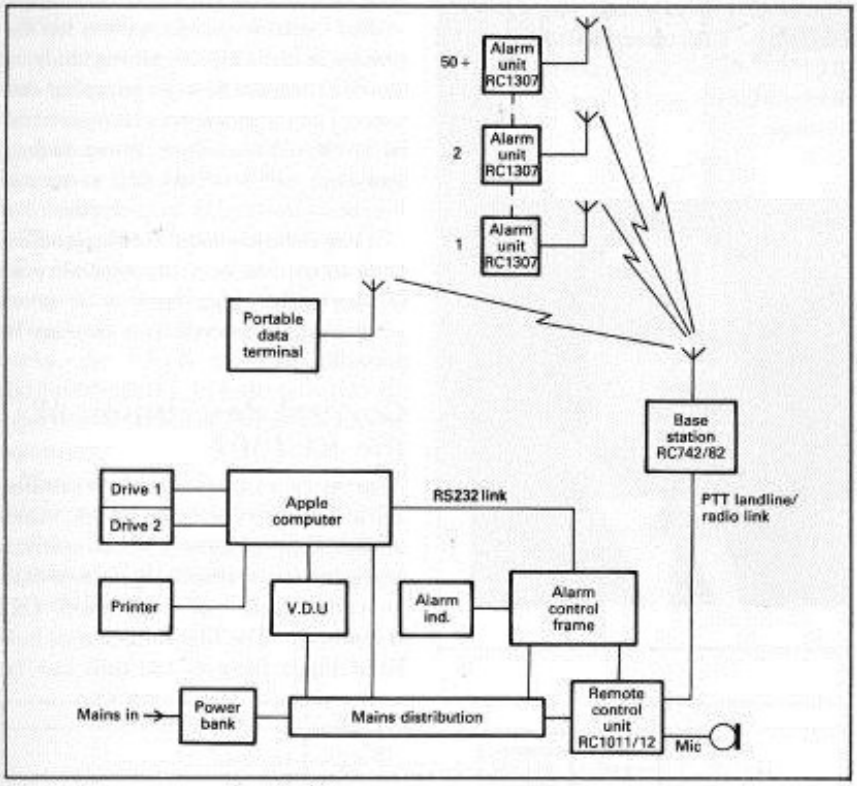

Fig. 3. Alarm system schematic diagram

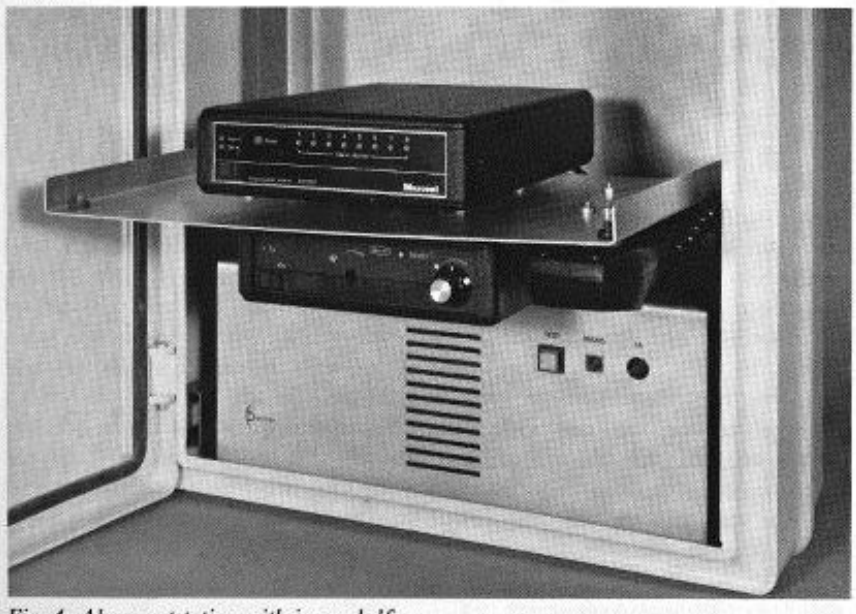

Fig. 4. Alarm outstation with inner shelf

selected to be active either on short or open circuit, thus enabling various forms of alarm sensor to be used.

On receipt of an alarm the unit sends as standard selcall:

a) its identity as coded on an internal header,

b) a final extra digit which indicates the active alarm input.

The RC1307 then requires an acknowledgement signal from system control indicating receipt of the alarm, which resets the unit to its monitoring state. Should the acknowledgement not be received, the unit will send the alarm again after an adjustable time delay, typically 40s, up to a maximum of five times after which the alarm is stored until the unit is interrogated.

Four input/output lines are available from the RC1307 to control its associated radio equipment. Alternatively these can be used as command lines, under radio control from system control, to perform control functions at the alarm outstation.

Selcall format

In order to simplify the interfacing of the alarm system to an existing radio scheme, standard selcall was chosen in preference to a fast frequency shift keying (f.f.s.k) based system. This means, in general, that users already in possession of a closed-channel selcall-based system can integrate the alarms very simply without the need for f.f.s.k radio modems.

The selcall system preferred by Marconi Mobile Radio is the EEA 5-tone system, but other standards such as CCIR or ZVEI can be provided if required (figure 2).

Alarm system description

Figure 3 is a block diagram showing how the RC1307 can be integrated into a typical system. In this arrangement there may be upwards of 50 alarm outstations, each with a maximum of eight alarms to be transmitted back to control. In this example, the RC1307 has been incorporated into a self-contained alarm outstation by fitting the unit inside a wall-mounting ABS enclosure along with an RC627 low-power telemetry transceiver and a float-charged, sealed, lead-acid battery. This is illustrated in figure 4.

As an alternative, the outstation can be supplied in a lockable steel cabinet for outside mounting where added security is required (figure 5).

In the initial requirement, approximately half of the alarm units were to be installed at remote, underground stations where no convenient means of fixing the unit existed. This problem was overcome by mounting each unit on a 5m high, 50mm diameter pole, set firmly into a concrete base, resulting in a neat and unobtrusive installation.

In the arrangement shown in figure 3 there may be as many as 400 different alarms to be identified as system control. In order to simplify interpretation, the incoming data is translated into plain English text before being displayed on the video display unit (v.d.u) and printer. A list file is also updated on the permanent storage medium, typically floppy disc, to enable a record to be kept of the active alarms over a long period of time.

Date and time information is displayed, this being generated by a real-time clock in the system control computer which allows statistical analysis of alarm and time data at a later date.

The control of the radio and selcall signals is performed by a microprocessor in the system control frame, this being under the command of the control computer via an RS232 data link. This has the advantage that the control computer, usually an Apple IIe, can be freed from the day-to-day running of the system, which is left to the processor in the control frame, and can be used for other purposes such as word processing. An interruption from the alarm control frame, or a command for interrogation, will automatically cause the system data to be displayed.

The complete system control is powered from a 240V uninterruptable power supply (u.p.s) in order to ensure system operation during mains failure or impulsive drop-outs. This can be a fairly important feature in a modern office environment where there may be many inherently noisy equipments connected to the mains supply.

System remote control

As already mentioned, communication between the various units of the system is by 1200-baud RS232 data. The choice of 1200 baud was deliberate in order to simplify one facet of the system operation, that of data transmission via a radio path.

Although all alarm information is passed from the outstations to the control in standard selcall format, this is a relatively slow means of transmitting data, taking approximately 200ms to send five digits. It was a requirement of the system that, in the event of an alarm during a period when the control was unmanned, all the information that would normally be displayed on the v.d.u should be transmitted to a portable terminal that would have the ability to control the system.

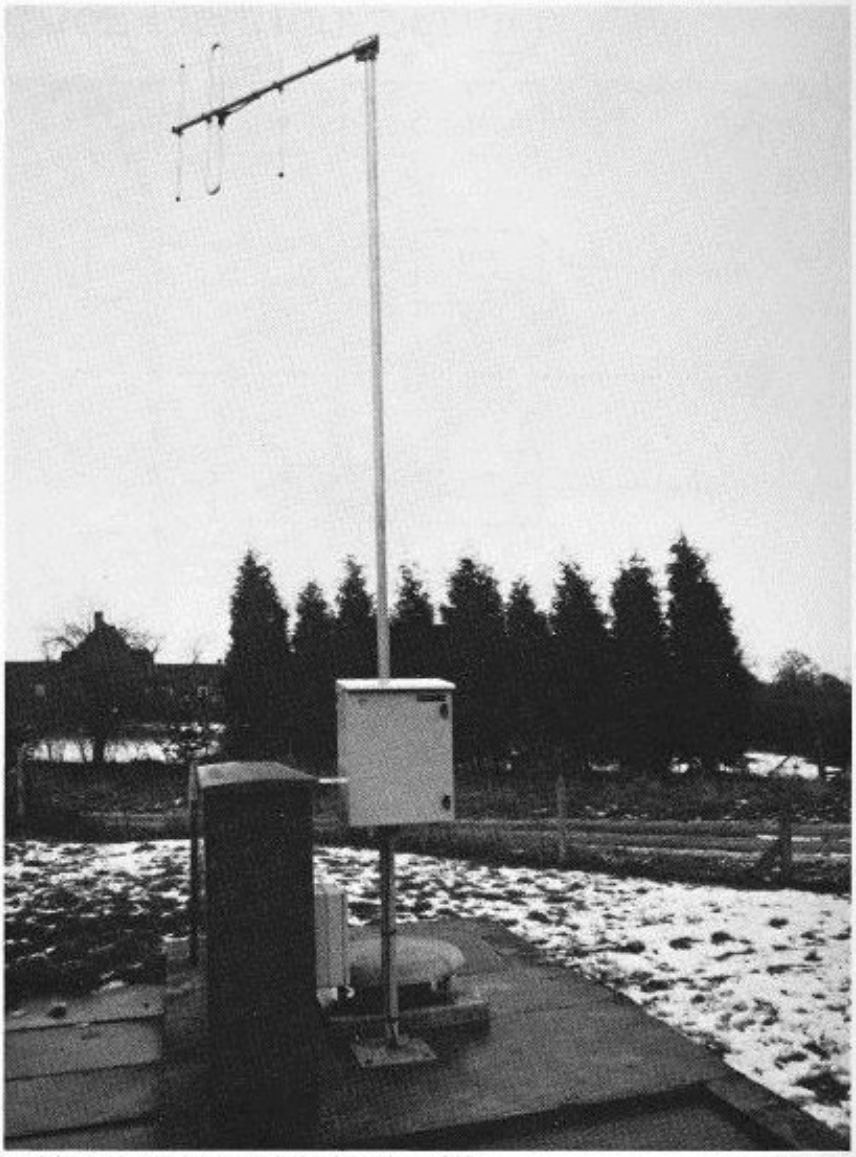

Fig. 5. Alarm outstation in lockable g.r.p cabinet

Because of this requirement a Portable Data Terminal (P.D.T) was developed consisting of an RC1700 Radio Modem, an RC627 V.H.F Transceiver, a miniature v.d.u and a 12V float-charged battery supply, all housed in a steel briefcase.

The terminal is based around the Marconi RC1700 Intelligent Radio Modem, a processor-controlled 1200-baud duplex modem designed specifically for use in the mobile radio environment. As can be seen from the block diagram (figure 6), the unit contains two microprocessors to buffer and control the data input/output. As the 1·2kHz system clock is generated by the processor, the data is output synchronously with the bit rate clock, thus alleviating the need for regenerating the clock in the modem itself. The RC1700 can be operated in either f.f.s.k or octave frequency shift keying (o.f.s.k) modes, these being switch selectable internally to allow for both of the more commonly used keying standards shown in Table 1.

Table 1: Keying standards

	O.F.S.K	F.F.S.K
Mark	2400Hz	1200Hz
Space	1200Hz	1800Hz
Start bits	1	1
Stop bits	2	2
Inter character space	1 bit	1 bit
Speed	1200 baud	1200 baud

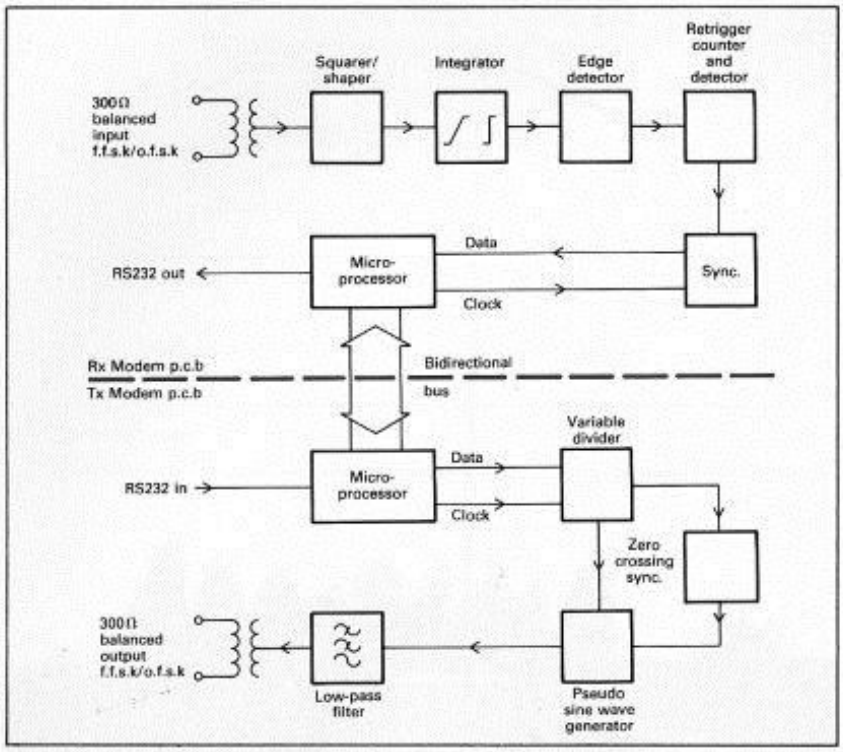

Fig. 6. RC1700 modem block diagram

due to its higher harmonic rejection and immunity to variations in pass band group delay.

Transmitter printed-circuit board

The RS232 data is input into a silo in the processor to allow for formatting and the addition of any error detection codes. After processing, the data is output synchronously with the 1·2kHz clock to the tone-generation circuitry. This consists of a phase-continuous variable divider feeding a 16-bit pseudo sinewave generator. The signal is filtered and buffered, then output through a 300Ω matching transformer to give a balanced pair. The p.c.b also provides a clean relay contact to key the associated r.f equipment with the correct timing for data transmission.

Receiver printed-circuit board

The f.f.s.k/o.f.s.k tones are transformer-coupled into a shaping and squaring circuit, then fed to an integrator and edge detector. This enables accurate detection of the zero crossing points which are then used to trigger a counter that is being clocked at a known rate. The counter outputs are decoded and fed via a synchronizing latch to the processor, where any error detection/correction can be performed before being output at 1200 baud to the RS232 generating circuit.

Opinion at present is that f.f.s.k gives better performance than o.f.s.k

Portable data terminal usage

The RC1700 is incorporated into the P.D.T to allow two-way speech and data communication from a remote location during periods when the main system control is unmanned. This ensures 24-hour operation without the need for continuous manning of the control centre which may be an important factor in the public utility sector. Thus a nominated duty officer can use the P.D.T from home, effectively giving 24-hour coverage where none existed before.

Conclusion

This alarm system supplied recently by Marconi Mobile Radio has proved to be a simple way of getting alarm data of high integrity across a radio path without disturbing the normal radio traffic on the channel to any great extent. Its main advantage has been in the reduction of the delay between failure and detection at very remote sites.

Previously it may have been days, even weeks, before a failure was detected at these locations. This has now been reduced to seconds, even in the most isolated conditions.

Further developments are likely but the success of the above scheme has shown the feasibility of larger schemes using the same basic principles.

References

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2. 'Selective Signalling for use in the PMR services', MPT 1316, (January 1981), HMSO.
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RÉSUMÉ

Le présent article décrit une récente addition à la gamme d'équipement Marconi Mobile Radio dans le domaine des systèmes d'alarme. Il illustre l'emploi de méthodes d'appel sélectif permettant la détection à distance par l'entremise d'une radio recevant des alarmes. Ceci permet par exemple de détecter des chutes de niveau de puits, des pannes de pompe ou de secteur à une station de pompage d'eau éloignée. Ces conditions peuvent être visualisées sur le panneau de commande du système et interprétées pour que l'on puisse alors intervenir. L'article donne également la description de l'unité d'alarme RC1307, du modem radio RC1700 et des systèmes qui leur sont associés.

RESUMEN

Este artículo describe una nueva adición a la gama de equipos que suministra Marconi Mobile Radio en el campo de los sistemas de alarma. Ilustra el empleo de métodos selectivos de llamada que permiten la detección por vía de un portador de radio de estados de alarma en una localidad remota. Esto permitiría, por ejemplo, la detección en una estación remota de bombeo de agua de los parámetros afines, tales como los niveles bajos del pozo, las averías de la bomba o una avería en la cañería principal. Estos pueden luego ponerse de manifiesto en el control del sistema para su interpretación, de suerte que puedan tomarse las medidas requeridas. Se describen también: la Unidad de Alarma RC1307, el Módem de Radio y sus sistemas asociados.

ZUSAMMENFASSUNG

Dieser Aufsatz beschreibt einen Zusatz zur Gerätereihe, die von Marconi Mobile Radio für Alarmsysteme geliefert wird. Dabei wird die Anwendung von Selektivrufmethoden vorgeführt, um Erfassung über eine Radiostrecke der Alarmzustände an einem entfernten Ort zu ermöglichen. Auf diese Art könnten beispielsweise Parameter wie niedrige Brunnenpegel, Pumpenausfall oder Netzausfall bei einer entfernten Wasserpumpenanlage erfaßt werden. Diese Zustände können dann zur entsprechenden Auslegung bei der Systemsteuerung angezeigt werden, um die entsprechenden Maßnahmen einzuleiten. Weiterhin beschreibt der Aufsatz das Alarmgerät RC1307, das Radiomodem RC1700 und die dazugehörigen Systeme.