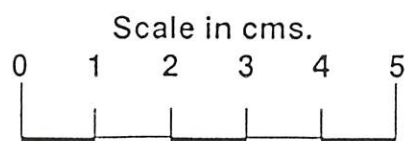
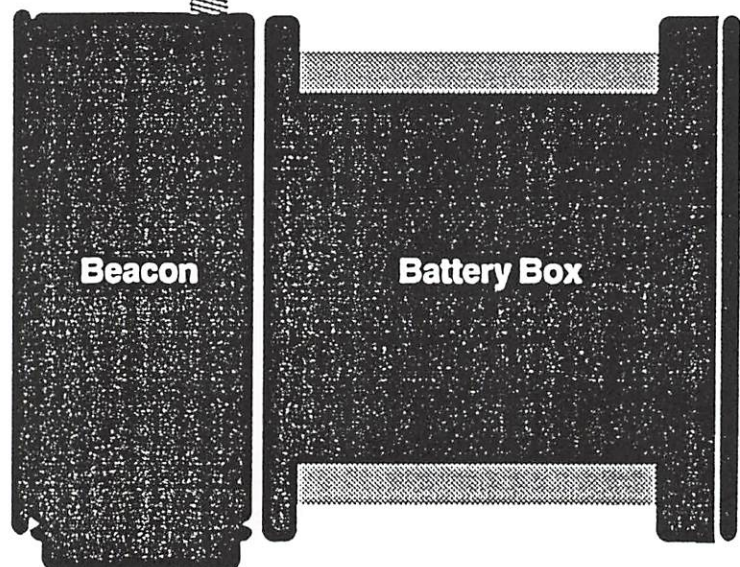


D903

Modular Multi-function Microprocessor
Controlled Beacon Transmitter/
Command Receiver
Confidential Data Sheet for Official Users Only



Model D903 is an advanced modular microprocessor controlled beacon transmitter and remote command receiver. Designed to be almost identical in function and performance to the D902, the D903 builds upon that beacon's existing features by adding smaller size, new external control facilities and a modular construction which allows the user to purchase only the parts necessary for his particular requirement. Power output is nominally 1 watt using internal lithium batteries or external power.

Although primarily a beacon transmitter, the D903 may find a purpose in many non-tracking applications where high integrity remote control of external equipment (eg cameras, tape recorders, etc) is required from a distance. If this is the case, the transmitter option need not be purchased or may be disabled.

Features of Basic Model

- 1 watt nominal power output from internal batteries.
- Internal battery holder designed to take two C size lithium cells for maximum mission time. Other battery holders may be available on request. External power may also be connected.
- Size greatly reduced if external power is used, without compromising facilities.
- Modular approach allows the user to suit the facilities to the operation. Four optional boards are available: Transmitter (*Option T*), Receiver (*Option R*), Sensor (*Option S*) and High current Output board (*Option I*) - any or all of these boards may be fitted giving the D903 as many facilities as is necessary.
- Rugged gasket-sealed milled aluminium case fitted with powerful low profile magnets and sealed 8-way screw terminals for connection of optional external power and (with the high current switching option fitted) providing access to auxiliary input/output circuits.
- Selectable transmission modes "continuous", "pulsed", and "fast pulsed" (which combines the excellent multipath performance of continuous mode with the ten times lower power consumption of a pulsed beacon - when used with Model DF4 "Tracker"). If used with other manufacturers' DF equipment, the user may set the beacon to replace the "fast pulsed" mode with a "wide pulsed" mode, if necessary.
- The transmitter circuitry has been redesigned to minimise, to an even greater extent than before, spurious outputs (harmonics, sub-harmonics, and key-clicks), thereby reducing the likelihood of breakthrough on vehicle radios.
- If the sensor board is fitted (*option S*), the transmitter, when "awake", continually indicates its state of motion (i.e. whether it is moving or stationary). This information can be heard audibly and is displayed automatically for the user on the DF4. In continuous mode the transmitter gives more detailed motion information by using the accelerometer output to frequency modulate the transmitter at very low deviation. Identification pulses are also sent in the same way.
- Goes to sleep (with very low power drain) after preset time interval after motion ceases. "Pre-sleep" delays selectable from 10 seconds, 10 minutes, 20 minutes or 12 hours.

- In "sleep" mode the beacon can be set to send a "confidence" pulse every 8 seconds. Confidence pulses can also be turned off completely to allow highly extended periods of inactivity (many months), and also decrease the likelihood of detection.
- When "awake" the transmitter also indicates the state of an external contact closure (the Auxiliary input).
- The transmitter can be set to "wake up" as a result of detecting motion, or an external contact opening, (or "logical AND/OR" combinations of the two). Or it can be set to ignore all of these and to wake up only on a radio command.
- User programmable features can be selected using internal DIL switches or by optional Remote Control.

Additional Remote Control Features

When the optional Remote Control receiver is fitted (*option R*), the following features are also available on the D903 using the matching remote control transmitter (Model CMD3) - this is supplied as a separate item since one transmitter can control a number of beacons. Users who have existing CMD2 units, may control many (but not all) the facilities available:

- All user programmable functions from selecting transmission modes, to sending the beacon to sleep can be performed by Remote Control.
- Command transmissions use error detecting coding for extremely low false-command probability.
- All radio commands are acknowledged by a reply code, except when acknowledgements are explicitly switched off.
- The unit can provide up to 2 logic level outputs which can each be remotely commanded by radio to go "high" or "low", and with the high current switching board fitted, 3 switched (FET) outputs which can sink 1.5 Amp loads at up to 30 Volts.
- Sixteen switch selectable address codes allow up to sixteen beacons to be controlled on a single radio channel, and a special "group polling" mode is also available, whereby all the beacons on the channel configured to accept a group message can be controlled simultaneously.

Basic Operation

The beacon is normally supplied as a base unit comprising a milled-out, weather-proof aluminium case containing the motherboard and microprocessor circuit boards and any of the optional extra circuit board (as required), a milled-out battery holder designed to accept two "C" size lithium cells (extra batteries can be supplied to order as separate items), sealing lids with rubber sealing rings which are used to weather-seal the case and powerful magnets fitted to the two main case sections.

Modular approach

Currently four additional circuit boards are available (each 50mmx28mmx5mm) which may be added to the beacon. Each board plugs into the motherboard inside the case and adds its own extra facilities, as follows:

Transmitter board (Option T)

If the D903 is to be used as a beacon transmitter, this board must be installed. It is a single frequency nominally 1 watt transmitter controlled by the microprocessor, and is used to generate the signal which can be heard and followed on the DF equipment. This circuit board will be necessary for most applications except where the D903 is used solely as a remote controller and the user does not require command acknowledgements.

Receiver board (Option R)

This board must be installed to allow the D903 to be controlled from a distance by the optional command transmitter (Model CMD3). It is a sensitive radio receiver which converts the FSK signal from the telecommander into a data stream which is read by the microprocessor.

Motion sensor board (Option S)

Only when the sensor board is fitted, can the beacon react to its movement status, and change its pulses or wake up accordingly. Without the sensor board fitted, the D903 constantly behaves as if stationary.

High Current Switching Board (Option I)

Without the high current switching board, the D903 has only 2 logic levels which can be controlled by remote control. As these are current limited to 0.5mA (CMOS outputs), they usually require connection to external circuitry before being of use. The high current switching board provides the user with a further 3 FET switches which can be "opened" or "closed" by remote control and can sink 1.5 Amps (at up to 30 Volts) each.

When ordering, please specify which of the boards are required by ordering a D903 followed by the letter(s) corresponding to the options required. (A D903 with all four options would be a D903TRSI).

D903 as a beacon transmitter

If used as a beacon (with the inclusion of the Transmitter option), the D903 will normally be magnetically fixed to a target vehicle or package. The target can then be tracked or followed for long periods using another vehicle fitted with direction finding equipment.

As well as revealing the target's direction and relative distance the transmitter also sends back information about its state of motion, and the status of an external switch or contact.

The transmitter is able to lie semi-dormant for long periods (still sending out a "confidence pulse" every few seconds), yet when motion or contact closure is detected (or when remotely commanded to do so) it "wakes up" and transmits a signal which allows the tracker to follow with minimum risk of losing contact. After motion stops the transmitter stays in its activated condition for typically 20 minutes before "going back to sleep." This allows the tracker time to close-in as required. (The "sleep hold-off" interval can be programmed by internal switches or Remote Control to 10 Seconds, 10 or 20 minutes or 12 Hours).

Three Out Of Four Selectable Transmission Modes

When the beacon is "awake", it can be made to operate in three main modes: "continuous", "pulsed", and "fast pulsed" or optionally "wide pulsed".

In "continuous" mode the transmitter sends out a continuous carrier wave, while in "pulsed" mode the carrier is chopped on and off with an approximate on-to-off ratio of one in ten. This mode gives ten times the battery life and would normally be chosen when maximum battery life is important.

When used with the Model DF4 tracker system, the special "fast pulsed" mode combines the excellent multipath performance of a continuous mode beacon with the ten times lower power consumption of a pulsed beacon. This mode takes advantage of the highly stable pulse timing which the microprocessor permits and allows DF4 to synchronise itself to the precise pulse repetition period of the beacon.

If the beacon is to be used with tracking systems other than the DF4 and which require longer pulse periods, the fast pulsed mode may be replaced by a special extended pulsed mode, by soldering a link on the microprocessor board.

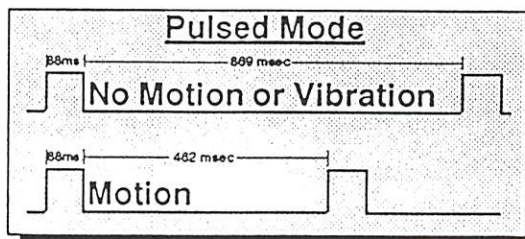
In all modes (as long as the sensor board is present) the beacon analyses the output from its vibration sensor and modifies the transmission so that the user can normally "hear" the difference between "no motion at all" and "vehicle moving". The beacon also audibly reports the status of an external switch contact (the "auxiliary" input) every few seconds.

When used with the Model DF4 tracker system the motion status of the beacon is displayed automatically on the control/display unit (pulsed modes only).

Pulse Timings

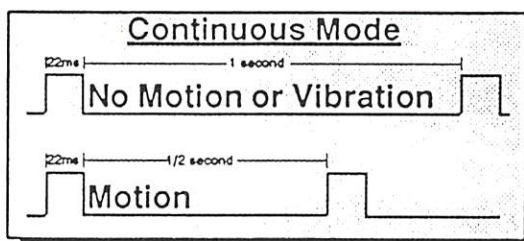
The pulse rates are similar to the D902 beacon, except for there being only one state of motion and for the provision of the extra extended pulsing mode.

In pulsed mode the transmissions are a series of pulses with a repetition rate and pulse width that depends on the motion status of the target and on the status of the auxiliary contact. The following table shows the timings:



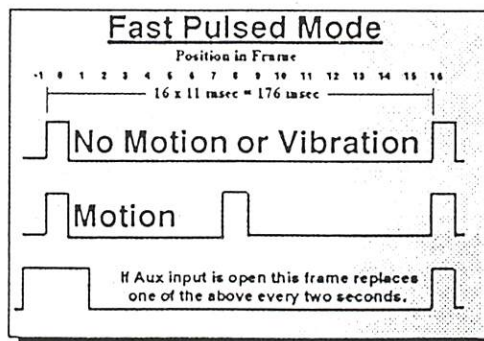
- * If the auxiliary contact is open, every fourth pulse is doubled in width.

In "continuous" mode the following pulse duty cycles are used and instead of turning the transmitter on and off they are used to frequency modulate the continuous carrier with a series of pips. In addition however, the output of the accelerometer is also used to frequency modulate the carrier and therefore gives more detailed information about the type of motion than is possible in pulsed mode. The information is detected by using a BFO (beat frequency oscillator) in the receiver:



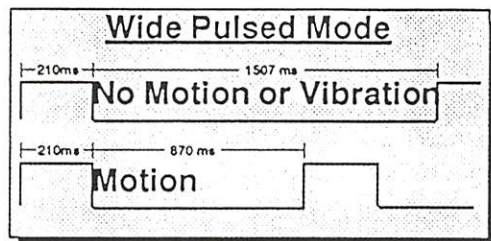
- * If the auxiliary input contact opens, every fourth "blip" is tripled in width.

The "Fast Pulsed" mode, when used with an appropriate tracking receiver (such as Model DF4), gives the extended battery life of the pulsed mode together with the good reduction of reflection effects of continuous mode. In this mode the transmitter produces pulses based on a precisely timed "frame" of nominal duration 176 msec (16 x 11 msec). The frame always contains at least one pulse, but extra ones are added to convey special information, as shown below:



Certain less sophisticated DF equipment may have problems coping with the ordinary pulsed mode of the D903. An option is therefore selectable by the user to allow the fast pulsed mode to be replaced by a pulsed mode with wider pulses.

As in normal pulsed mode, this mode changes its pulse repetition rate according to the state of motion:



- * If the auxiliary contact is open, every 4th pulse is doubled in width.

Sleep Mode

In any transmission mode, when all movement has finally stopped the transmitter remains activated for a user determined "sleep hold-off period", after which the "sleep" mode begins.

Here the transmitter gives one pulse approximately every 8 seconds (depending on user selection) and battery consumption is therefore very low. These "confidence pulses" serve to reassure the tracker that the transmitter is still operational. In the event that the tracker temporarily loses contact, they would allow the target to be relocated.

Wake-Up Selection

When first switched on the transmitter is programmed to wake up only when motion occurs, however using the internal switches (or by remote control) the transmitter can be reprogrammed so that wake-up occurs only when the auxiliary input is open, or only when both auxiliary and motion occur or when either happen. The beacon can also be instructed by remote control not to wake up until another remote command is received.

Remote Control

With the receiver board inserted, the D903 allows most of the user selectable functions to be remotely determined without having to open the case, (in order to get at the switches). This requires the optional CMD3 command transmitter, and allows Remote Control of the beacon over several miles.

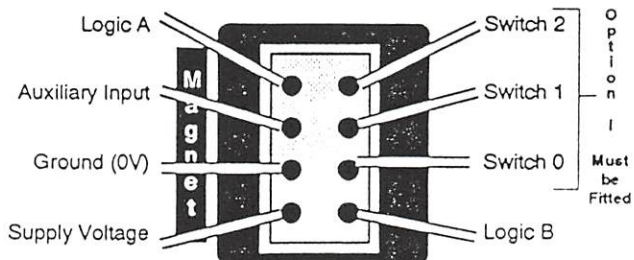
Every second whether "asleep" or "awake" the remote controlled beacon stops transmitting and briefly switches on the receiver. If it receives a valid command it responds by sending an acknowledgement code which sounds like slow Morse code and which corresponds to the command sent. In this way the user can

be certain that the desired command has been activated.

Sixteen different address codes can be selected using internal switches so that up to sixteen beacons can share the same radio channel. The beacons can also be configured to accept commands addressed to a special "group" address if required, thereby allowing several beacons on the same channel to be controlled simultaneously.

Accessory Connector

An 8 way screw terminal connector gives access to the auxiliary input, the external 7V supply input (12V can be connected by using the model BVR1 voltage regulator), 2 remote commandable CMOS logic outputs and (when the high current switching board is fitted,) 3 FET switches which can sink up to 1.5A. Other configurations and connections may be possible on request.



Battery Life

Model D903 gives optimum battery life because its automatic "wake up" feature saves battery current when the target is not doing anything interesting. In pulsed modes one set of batteries will give over 100 hours of steady pulsing.

Antenna

The beacon comes supplied with a miniature antenna pre-tuned to the specified operating frequency. The antenna connects via a standard miniature coaxial connector, and it is the action of plugging in the antenna which switches on the beacon. An external antenna can also be used if desired (connection instructions are given in the manual).

Complete Kit

Model D903 is supplied in a durable foam lined carrying case and with the following accessories: alternative sealing plates and fixing screws for when the battery pack is not used, keeper plate for the magnets, loaded whip antenna, a screwdriver and one set of batteries.

Technical Specification

Measurements are made using a supply voltage of 7.0 volts unless otherwise stated.

Nominal transmitter power output: Typically 1 watt into 50 ohms
 Level of spurious output: Typically 55db below carrier into resistive load
 Supply current (during transmit pulse): 350 mA (antenna connected)
 Supply current while receiving: 8 mA
 Supply current while asleep: 200 microamps
 Maximum safe supply voltage: 8V (safe maximum) 7V (typical)
 Key Click Suppression: To minimise sideband energy due to pulsing the carrier, the microprocessor ramps the power supplies to the oscillator, driver, and power stages of the transmitter up and down in a carefully controlled sequence. The spectral width of the transmission in "fast pulsed" mode is less than 6 KHz at -50 db relative to carrier.

Command Receiver Sensitivity for 75% probability of correct decode: Typically -118 dbm
 Type of command transmission: FSK
 Frequency range: 30 to 180 MHz to order.
 Frequency Control: Quartz crystal
 Deviation for command channel: 4 kHz pk-pk
 Switch-selectable address codes: 16
 Coding method: Error detecting split-phase code.
 Microprocessor: 8-bit CMOS

Dimensions (including magnets & battery pack): 95 x 75 x 37 mm (3.7 x 2.9 x 1.5 inches)

Dimensions (including magnets but without battery pack): 37 x 75 x 37 mm

(1.5 x 2.9 x 1.5 inches)

Weight (including batteries): 364 g

Antenna: Base loaded whip, cut to appropriate length for operating frequency

Finish: Black anodised

Advantages of D903 over D902R

- * D903 is smaller, lighter & modular
- * "Wide Pulsed" Mode
- * Extra Switching Outputs
- * Deep Sleep/Radio Silence Mode
- * Sixteen Beacon Addresses
- * Group Polling Available

Optional Accessories

- * Commander unit for remote control of D903 Model CMD3
- * Spare antennas (please state frequency) Model SAB
- * Voltage Converter (12V to 7V) Model BVR1
- * Extra Lithium Batteries (2 required per beacon) LSH14

The information in this data sheet is subject to revision without prior notice