Contents

6 June, 2003

Introduction

This manual covers the operation of the ***MoTeC*** Lap Beacon system.

The ***MoTeC*** Lap Beacon system consists of a Beacon Transmitter (BTX) and a Beacon Receiver (BR2).

The Beacon Transmitter is mounted beside the track and the Beacon Receiver is fitted in the vehicle and connected to a Data Logging or Engine Management system.

The Lap Beacon system is used to mark the start of a lap. This can be used by a display to show the driver lap times and lap number and can be used by a data logging system for lap time and start of lap information. The Lap Beacon may also be used to generate split times by placing multiple transmitters around the race circuit.

Overview

Operation

The Beacon Transmitter emits a narrow infrared beam, which is encoded with a number that will only be detected by a receiver system with the same number. There must be no obstacles between the receiver and the transmitter.

Code Number

The ***MoTeC*** Lap Beacon has 1000 different code numbers. The code number allows the beacon system to ignore all transmitters other than one with the correct code number.

Recommended Code Number Settings

The *Mode* switch is used to avoid two teams in different race categories from using the same beacon code.

- 999 is reserved for a master beacon that can be setup for the use of anyone at a race meeting.
- Modes E and F are for use with Pi 2 and Pi 4 equipment respectively.

Transmitter

The code number is selected by setting the *Mode* & *ID* (Tens & Units) switches inside the transmitter to the desired number as mentioned above.

To access the switches first disconnect the power then undo the four screws and remove the front cover of the unit.

Receiver

The BR2 Beacon Receiver has two different connection methods: CAN Bus or Switched Output. The setup requirements of the Receiver are different depending on which connection method is used.

Note: DO NOT remove the cover of the BR2, there are no configuration switches inside.

CAN Bus Connection Method

This is the recommended method for use with the ***MoTeC*** ADL, and the only method for use with an MDD.

When the receiver detects any Beacon Transmitter it sends the transmitter number to the connected device via the CAN Bus.

ADL

The ADL must be configured to use the same *Mode* and *ID* as the Transmitter. All other beacon transmitters will be ignored.

The BR2 Beacon Receiver does not normally require the configuration to be changed when used with an ADL. See the *Beacon Receiver* section for more detail.

MDD

The MDD does not require configuration however a special configuration method is required for the Beacon Receiver when used with the MDD. This is done using the BR2 Configuration program. See the *Beacon Receiver* section for more detail.

Switched Output Connection Method

This method is used for other ***MoTeC*** devices that do not support the CAN Bus connection method such as the ***MoTeC*** M8 and M800 ECU.

The BR2 must be configured to only recognise a particular beacon. This is done using the BR2 Configuration program.

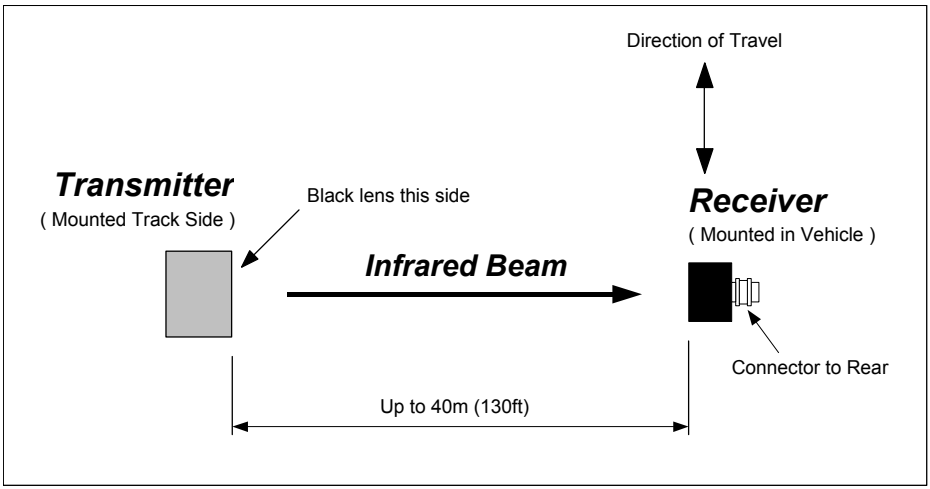
When the BR2 detects a transmitter with a matching *Mode* and *ID* a signal is sent to the connected device via the switched output.

See the *Beacon Receiver* section for more detail.

Orientation

The transmitter and receiver must be oriented as shown below.

There must be no obstacles between the receiver and the transmitter.



Range

The ***MoTeC*** Lap Beacon system has a range of up to 40m (130ft).

Note: If the receiver is aimed through tinted glass or tinted acrylic sheet (Plexiglass/Perspex) the range may be reduced substantially. This needs to be checked for the particular installation by checking the operating range. Clear glass or clear acrylic sheet is normally OK.

In all cases the range should be tested to ensure that it is at least 1.5 times the required range. For example, if a range of 10m is required then the tested range must be at least 15m. The additional range allows a margin to ensure that a reliable signal is received under all conditions.

See *Appendix A – Range Specification* for more detail.

Alignment

Both the transmitter and receiver must be aligned to within 5° of optimum (preferably 2°)

Verifying Operation

See the *Trouble Shooting* section for test procedures.

Split Beacon Use

The ***MoTeC*** Lap Beacon may also be used to generate split times by placing multiple transmitters around the race circuit. Commonly these are given the same *Mode* setting but different *ID's*. In this case the ADL will treat all beacons matching the configured *Mode* value as split beacons.

Alternatively, if you wish to use only some beacons as split beacons, or use beacon transmitters with different *Mode* settings, then these must be listed using the Advanced Configuration of the BR2 setup software. This is used to re-map the beacons to a common *Mode* number.

Split beacons are generally only suitable for private practice, however beacon *Mode* 9 has been allocated specifically for split beacon use. It is important to ensure that only the beacons for split usage are operating on *Mode* 9 otherwise unexpected beacon signals may be received. Beacon number 999 has been reserved as a master beacon, therefore this *ID* should generally be used as the lap beacon. The software for the connected device will normally need to know the number of the transmitter that marks the start of the lap.

The receiver setup requirements depend on the connection method. See the *Beacon Receiver* section for more detail.

Configuration - Quick Start

This section is for users who are familiar with the ***MoTeC*** system of lap timers and briefly covers the configuration required to connect the BR2 to various ***MoTeC*** devices without the presence of split beacons.

More detailed information is available in the *Configuration* section.

ADL (using CAN)

The CAN connection method is the recommended method for connecting the BR2 to the ADL and is detailed here.

The beacon *Mode* and *ID* do not need to be set in the BR2, instead they are set in the ADL. This is possible because the BR2 informs the ADL of all beacons that it sees, this allows the ADL to decide which beacon to use.

The BR2 can also be connected using the Switched Output method, as detailed in the *Configuration* section.

BR2 Configuration

Normally the configuration does not need to be changed since CAN operation is the factory default and the *Mode* and *ID* do not need to be entered in the BR2.

ADL Dash Manager Version

Ensure that the Dash Manager Install is version 2.10F2 or higher and that the latest firmware has been sent to the ADL.

ADL Lap Time and Number Setup

Set the *Beacon Type* to ‘BR2 (on CAN)’ and set the *Mode* and *ID* to match the Transmitter.

ADL BR2 CAN Communications Template

The ADL must have the BR2 CAN communications template loaded. The template can be loaded in the *Inputs* | *Communications Setup* on one of the CAN tabs.

Note: The 'Beacon' channel must be ticked on. In older configurations the Beacon channel may already be assigned to a digital input, in this case the beacon must be deleted from the Digital Input so that the beacon channel can be ticked on in the CAN setup.

Diagnostic Channels

The BR2 sends a large number of diagnostic messages to the connected device, in the standard BR2 CAN template most of these are turned off. To use the additional messages tick them on in the CAN setup.

M8 or M800 ECU

The BR2 must be configured for Switched Output and the *Mode* and *ID* of the Beacon Transmitter must be entered.

The ECU must have a digital input configured for beacon operation. The polarity must be set to 'Active when input low'.

See the *Configuration* section for more detail.

MDD

The BR2 must be configured to use the CAN connection. Additionally the BR2 Advanced Configuration settings must also be enabled and the *Mode* and *ID* entered as the first (and normally the only) beacon in the *Advanced Configuration Settings* list.

This will require use of the BR2 Configuration Program that is installed with Dash Manager version 3.00 and later.

Note: To add the *Mode* and *ID* to the list under *Advanced Settings*, the *Mode* and *ID* must first be selected then the *Add* button must be clicked which will copy the settings to the list.

The MDD itself does not require configuration.

See the *Configuration* section for more detail.

BTX Beacon Transmitter

Position

The beacon transmitter may be placed at any point around the track.

- It is recommended that the beacon transmitter is always placed in the same position at a particular track. This avoids offsets when data from a previous session needs to be compared with the current data. If the same position cannot be used then the ***MoTeC Interpreter*** software can compensate for the offset in the beacon position.
- To ensure that the lap time recorded is the same as the official lap time, the beacon transmitter should be placed close to the official timing point – normally located at the start/finish line.

Spacing between Transmitters

The spacing between adjacent transmitters must be at least 6m (20ft) to avoid the signals from each transmitter conflicting with each other. This also includes other manufacturers' beacons that emit an infrared beam.

Mounting

The beacon transmitter has 4 holes outside the sealing ring of the case. These holes may be used to mount the unit to a backing plate. Note that the backing plate should include a hole so that the power LED is visible.

Note that any mounting system must ensure that the case remains watertight.

The transmitter should not be mounted in an enclosed case as very high temperatures can cause a reduction in transmission power.

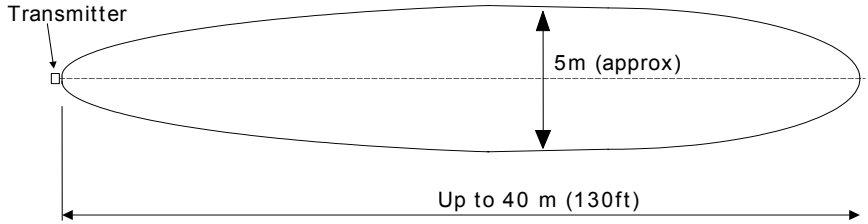
Aiming / Range

The Beacon Transmitter must be aimed so that the infrared beam is parallel to the road and at the same height above the road as the vehicle receiver, therefore the mounting system must be capable of height and tilt adjustment.

The unit must be mounted within 5 degrees (2 degrees preferred) of optimum.

Beam Pattern

The approximate infrared beam pattern is shown below. The pattern shows the limits of operation.



Code Number Adjustment

Turn the power off before adjusting the code number to avoid accidental damage to the electronics.

The code number is set using the rotary switches inside the unit. To access the switches remove the 4 screws from the front cover of the unit.

LED

The LED has three colours that have the following meanings:

Green	OK
Orange	Low battery voltage (Less than 10.5V)
Red	Fault or very low battery voltage

- The beacon transmitter will operate when the LED is orange, however the transmitted power is reduced which reduces the operating range.

Power

The unit should be powered from a 12V rechargeable battery. A small sealed lead acid battery is recommended as it can be easily charged and will operate the transmitter for several days. A capacity of 10Ahr or greater is recommended. The battery may also be used as a weight at the base of the mounting system for stability.

Connect the red wire to battery positive, and the black wire to battery negative.

Note that the unit requires at least 10.5 V for proper operation.

It is recommended that the battery be charged regularly to ensure good battery life.

See *Appendix G - Transmitter Wiring* for connection details.

BR2 Beacon Receiver

Mounting

The BR2 mounting may need to be designed to allow it to be mounted at either side of the vehicle, depending on which side of the track the transmitter will be located. See *Appendix L – BR2 Mounting Dimensions* for details.

Notes:

- The receiver window (rectangular black window) and LED must not be obscured.
- Do not mount near a radio transmitter or radio transmitter antenna.
- Do not mount near the engine ignition system.

Range

The ***MoTeC*** Lap Beacon has a range of up to 40m (130ft).

See *Appendix A – Range Specification* and *Range* in the *Overview* section for more detail.

Aiming

The unit must be mounted within 5 degrees (2 degrees preferred) of optimum. See the diagram in the *Overview* section for details.

Maintenance

Keep the receiver window clean (the rectangular black window).

Ensure that the BR2 is aligned correctly - within 5 degrees of optimum (2 degrees preferred)

LED

The LED on the front of the BR2 is used for the following purposes:

Power On

At power on the LED will turn on for about two seconds, indicating that power has been connected.

The LED may also flash a couple of times immediately after power up but this should stop after a few seconds.

Valid Beacon Signal

When the BR2 receives a valid beacon signal the LED will emit a short bright flash. A beacon event signal is sent to the connected device when the LED flashes. Note that the LED will continue to glow while receiving a valid beacon signal.

The short bright flash is emitted once only as soon as the beacon signal is recognised. It will not flash again until the beacon signal has been completely removed and then reappears, or a different beacon signal is detected.

Note that when testing the beacon system with the vehicle stationary and in a confined space it may be necessary to remove the transmitter power then reapply it before the receiver LED will flash again. This is because the transmitter signal can reflect off other objects so the receiver will not recognise the transmitter signal as having stopped even when the transmitter is pointing away from the receiver.

If the BR2 is configured for the CAN connection method then the LED will flash for every beacon that it recognises including transmitters with a different *Mode* and *ID*.

If the BR2 is configured for the Switched Output connection method then the LED will only flash when it detects a transmitter with a matching *Mode* and *ID*. Note that if the BR2 is configured for split beacons (*ID* = any *ID*) then the LED will flash for any transmitter with the matching *Mode* and any *ID*.

Error Codes

The BR2 will emit an error code if it has a serious problem. The error codes are in the form of a number of flashes followed by a pause. The number of flashes indicates which error has occurred. See *Appendix E – BR2 LED Error Codes* for details.

Other

The LED may also glow dimly or erratically if it is receiving electrical interference or a signal from another infrared source.

Connection Methods

The BR2 has two connection methods: CAN (Controller Area Network) or Switched Output.

CAN Connection Method

The CAN connection method is the preferred method for connecting to the ADL and the only method for connection to an MDD.

The BR2 should be connected to the vehicle CAN Bus. See *Appendix J – BR2 Wiring* for details.

This method allows the BR2 to provide additional information to the ADL, which provides improved diagnostic capabilities. The information that is sent to the ADL is documented in *Appendix D – BR2 CAN Messages*.

Switched Output Connection Method

The Switched Output connection method can be used to connect to other devices that do not support the CAN connection method such as a ***MoTeC*** M8 or M800 ECU.

The BR2 should be wired to a suitable Digital Input on the ECU. See *Appendix H – BR2 Wiring (Switched Output)* for details.

Special Notes

Both outputs are always used as follows:

CAN Mode

In CAN Mode the Switched Output is pulsed for every beacon received. The BR2 could be used to trigger another device with its switched output, while sending beacon signals to the ADL via CAN.

The LED diagnostics ignores an error on the Switched Output.

Switched Output Mode

In Switched Output mode all beacons are transmitted on the CAN Output (as normal).

The LED diagnostics ignores an error on the CAN output.

Configuration

Both the BR2 and the connected device (e.g. ADL or ECU) must be configured to suit the connection method, including the *Mode* and *ID* numbers.

Note: Do not open the cover of the BR2 there are no configuration switches inside the unit.

BR2 Configuration Program

The BR2 Configuration program is used to check or change the configuration. The configuration program communicates with the BR2 via the same CAN Cable that is used to communicate with other CAN devices such as the ADL.

If the BR2 has not been wired for CAN, then a standalone wiring loom will be required for configuration. (See *Appendix F – BR2 Configuration Loom* for details).

***Note*:** the BR2 Configuration program is installed when Dash Manager version 3.00 or later is installed.

Starting the BR2 Configuration Program

A shortcut to the program can be found under the Windows *Start* menu.

Start | *Programs* | *MoTeC* | *Utilities* | *BR2 Configuration*

Note that the BR2 should be connected to the PC via the CAN Cable and powered up.

Checking the BR2 Configuration

To check the configuration in the BR2 click on the *Get Config* button and the screen will be updated to reflect the connected BR2's configuration.

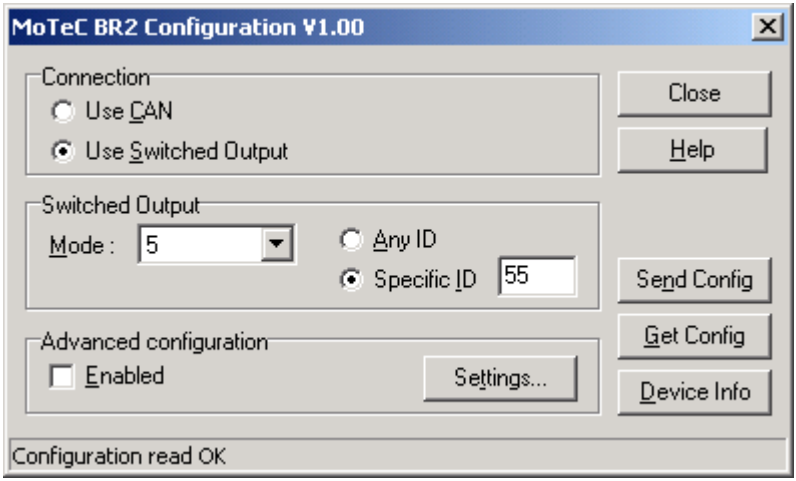
Note that the configuration is also automatically retrieved from the BR2 when the BR2 Configuration program is started so clicking on *Get Config* is not normally required.

Sending the Configuration to the BR2

After selecting the correct setup information, the configuration must be sent to the BR2 by clicking on the *Send Config* button.

BR2 Configuration Example

In the example below the BR2 is configured to use the Switched Output connection method and the BR2 will respond to a beacon transmitter with a *Mode* setting of 5 and an *ID* of 55.



BR2 Configuration

The method for configuring the BR2 is dependent on the connection method and the device that it is connected to as follows:

For ADL using CAN Connection

The BR2 must be configured to use the CAN connection.

The beacon *Mode* and *ID* do not need to be set in the BR2, instead they are set in the ADL.

***Note*:** Normally the configuration does not need to be changed since CAN operation is the factory default.

Split Beacons

The BR2 does not require further configuration if the split beacons all use the same *Mode* as the Lap Beacon.

Split Beacons that have a different *Mode* from the Lap Beacon can be used by enabling the advanced configuration feature of the BR2. Refer to Special Split Beacons (for ADL) latter in this section.

For ADL using Switched Output Connection

The BR2 must be configured for Switched Output connection and the *Mode* and *ID* of the Beacon Transmitter must be entered.

Note: it is normally best to use the CAN connection method when connecting to the ADL.

Split Beacons

If the split beacons all use the same *Mode* as the Lap Beacon then the BR2 should be configured so that the *Mode* is set to match the *Mode* used by the transmitters and 'Any ID' should be selected.

The BR2 will send a signal to the ADL for every transmitter with the specified *Mode*.

Split Beacons that have a different *Mode* from the Lap Beacon can be used by enabling the advanced configuration feature of the BR2. Refer to Special Split Beacons (for ADL) latter in this section.

For M8 or M800 ECU

The BR2 may be used with an M8 & M800 ECU using the switched output connection method.

The BR2 must be configured for Switched Output and the *Mode* and *ID* of the Beacon Transmitter must be entered.

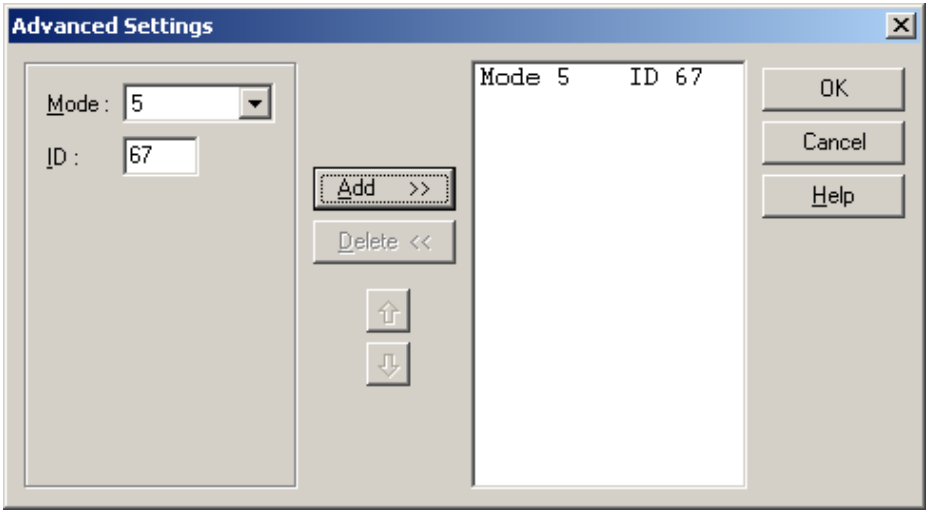
For MDD

The BR2 must be configured to use the CAN connection.

The Advanced Configuration settings must also be enabled and the *Mode* and *ID* must be entered as the first (and normally the only) beacon in the *Advanced Configuration Settings* list.

To add the *Mode* and *ID* to the list the *Mode* and *ID* must first be selected then the *Add* button must be clicked which will copy the settings to the list.

The Advanced Settings screen is shown below with a *Mode* and *ID* already added to the list.



Connected Device Configuration

The connected device (e.g. ***MoTeC*** ADL, MDD or ECU) must be configured to accept the signal from the beacon receiver.

The method for configuring the connected device is dependent on the connection method and the device that it is connected to as follows:

For ADL using CAN Connection

Dash Manager Version

Ensure that the Dash Manager install is version 2.10F2 or higher and that the latest firmware has been sent to the ADL by selecting *Online* | *Upgrade Dash Version*.

Lap Time and Number Setup

The *Beacon Type*, *Mode* and *ID* should be entered into the *Lap Time and Number* setup.

BR2 CAN Communications Template

The BR2 CAN communications template must be loaded so that the ADL knows what to do with the messages that are sent from the BR2.

The template can be loaded in the *Inputs* | *Communications Setup* on one of the CAN tabs.

Note: The 'Beacon' channel must be ticked on. In older configurations the Beacon channel may already be assigned to a Digital Input, in this case the Beacon must be deleted from the Digital Input so that the beacon channel can be ticked on in the CAN setup.

Diagnostic Channels

The BR2 sends a large number of diagnostic messages to the connected device, in the standard BR2 CAN template most of these are turned off. To use the additional messages tick them on in the CAN setup. For details of the meaning of each message, see *Appendix D – BR2 CAN* Messages.

Split Beacons

The ADL automatically handles split beacons if the *Mode* is the same for all beacons including the Lap Beacon.

Split Beacons that have a different *Mode* from the Lap Beacon can be used by setting up the advanced configuration feature of the BR2. Refer to Special Split Beacons (for ADL) latter in this section.

Note: The *Split Lap Times* channel should be turned on if split times are to be displayed on the ADL.

ADL using Switched Output Connection

Lap Time and Number Setup

A *Beacon Type* of 'BRX' should be entered into the *Lap Time and Number* setup. This is because that when the BR2 is used in Switched Output mode, it functions like an older style BRX beacon receiver.

The beacon *Mode* and *ID* are not required as these are set in the BR2 and the BR2 will only output a signal when this beacon is detected.

Digital Input Setup

The ADL must be configured to receive the signal on a Digital Input.

Configure the Digital Input to feed the 'Beacon' channel and set the logic polarity to 'Low Volts = Active'.

Split Beacons

The ADL automatically handles split beacons if the *Mode* is the same for all beacons including the Lap Beacon.

Note that the *Beacon Type* must be set to 'BRX with Splits' and the *ID* of the Lap Beacon must be entered.

Split Beacons that have a different *Mode* from the Lap Beacon can be used by using the advanced configuration feature of the BR2. Refer to Special Split Beacons (for ADL) latter in this section.

Note: The *Split Lap Times* channel should be turned on if split times are to be displayed on the ADL.

For M8 or M800 ECU

A digital input must be configured for Beacon operation.

The polarity must be set to 'Active when input Low'.

For MDD

The MDD does not require configuration.

Special Split Beacons (for ADL)

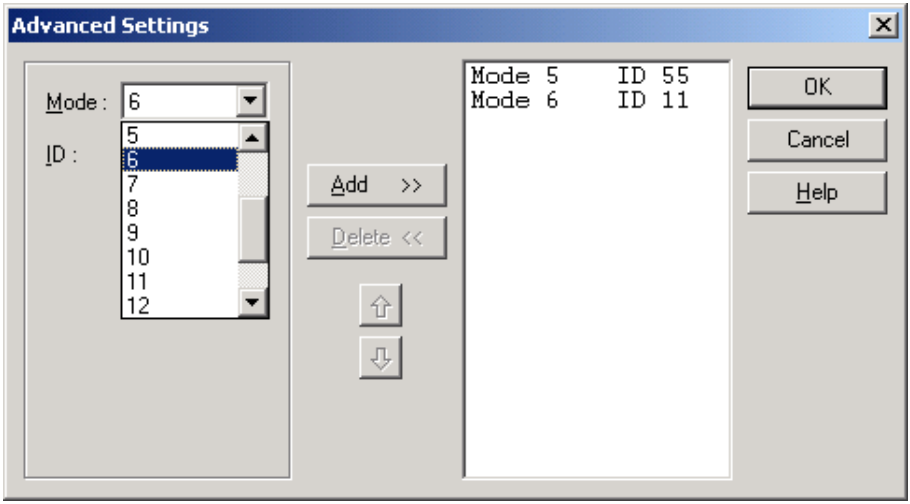
Split Beacons that have a different *Mode* from the Lap Beacon can be used by configuring the advanced configuration feature of the BR2.

To change the advanced configuration click on the Advanced Configuration *Settings* button.

Each beacon that is to be used must be entered into the list.

To add a beacon to the list, select the *Mode* from the drop down list, enter the *ID*, and then click the *Add* button.

The Advanced Settings screen is shown below with two beacons already added to the list.



For CAN Connection

The beacons specified in the list are transmitted under a different *Mode* and *ID*. The *Mode* will be 100 and the *ID* will be based on the order in the list. Note that the *Mode* is 100, not 1. The first beacon in the list is transmitted with the beacon *ID* equal to zero, the second with the *ID* equal to one, etc.

Any beacons that are not in the list will be sent without modification, but will normally be rejected by the ADL.

The ADL must be configured to receive on *Mode* 100 (not *Mode* 1). The Lap Beacon *ID* must be set in the ADL to match the transformed *ID* of the Lap Beacon. For example if the Lap Beacon is the first *ID* in the list then an *ID* of 0 must be entered, if second in the list then 1 must be entered.

For Switched Output Connection

The beacons specified in the list are transmitted under a different *ID*. The *ID* will be based on the order in the list. The first beacon in the list is transmitted with the *ID* equal to zero, the second with the *ID* equal to one, etc. Note that the *Mode* is not transmitted when using the Switched Output.

The BR2 will pulse the output for every beacon listed in the table, all other beacons will be ignored.

The ADL must be configured to receive on *Mode* 100 (not *Mode* 1). The Lap Beacon *ID* must be set in the ADL to match the transformed *ID* of

the Lap Beacon. For example if the Lap Beacon is the first *ID* in the list then an *ID* of 0 must be entered, if second in the list then 1 must be entered.

Trouble Shooting

1. Check the Transmitter

1A. Check the Transmitter LED

Green

OK

Orange

The battery voltage is less than 10.5 Volts, the battery requires charging.

Red

- If the battery voltage is less than 10.5 Volts then the battery should be charged.
- If the battery voltage is greater than 10.5 Volts, there may be a fault with the Transmitter.

Off

Check that the battery is connected correctly, Red wire to battery positive, Black wire to battery negative and that the battery is supplying at least 10.5 volts.

1B. Check the Transmitter Aiming

Check that the Transmitter is aligned correctly, it must be within 5° of optimum (2° preferred).

1C. Check the Transmitter Spacing

Check that the Transmitter is at least 6m (20ft) from adjacent transmitters.

2. Check the Receiver

2A. Power

Check that the Receiver LED emits a short flash when power is applied.

2B. Error Codes

If the LED continues to flash after power is applied then it may be emitting an error code. See *Appendix E – BR2 LED Error Codes* for details.

2C. Valid Signal

To check that the Receiver is detecting the Transmitter signal:

a. Firstly, the Transmitter signal must be completely removed from the Receiver, this is best done by disconnecting the Transmitter power. Note that simply aiming the transmitter away from the receiver may not be enough since the transmitter signal will bounce of walls and other objects.

b. Point the Transmitter at the Receiver and turn the power on. The Receiver LED should emit a bright flash when it recognises the transmitter signal. The LED will continue to glow while the Transmitter is aimed at the Receiver.

Possible Problems

If the Receiver does not emit a bright flash when the transmitter is turned on, it may be for one of the following reasons:

a. The signal was not completely removed first.

b. The BR2 is configured for Switched Output mode and the *Mode* and *ID* do not match the setting in the Transmitter.

2D. Check the Receiver Aiming

Check that the Receiver is aligned correctly, it must be within 5° of optimum (2° preferred).

2E. Check the Receiver Wiring

Check the wiring for intermittent connections or damaged wires.

3. Check the Connected Device (for ADL)

3A. Check the Lap Time

Use the following procedure to check the Lap Time on the ADL with the vehicle stationary:

a. Take the Transmitter to a point directly in line with the Receiver and not more than 40m (130ft) away.

b. The Transmitter signal must be completely removed from the Receiver. This is best done by disconnecting the Transmitter power.

c. Aim the Transmitter at the Receiver and connect the Transmitter power. The Receiver LED should emit a bright flash when it recognises the transmitter signal. The ADL Running Lap Time (if configured) should start incrementing as soon as the transmitter is detected, however the Lap Time may stay at zero if this is the first beacon signal since the Lap Time was reset. Note that the *Mode* and *ID* must be set to match the Transmitter in the ADL configuration (for CAN operation).

d. To record a Lap Time the Transmitter signal must again be completely removed from the Receiver by disconnecting the Transmitter power. Wait for a period exceeding the *Beacon Ignore Time* then aim the Transmitter at the Receiver and reconnect the power. The Receiver should emit a bright flash, the ADL Lap Time should update, and the Running Lap Time (if configured) should go to zero and start counting up again.

Note: the Lap Time will only be recorded if the time between signals was greater than the *Beacon Ignore Time* (usually 5 seconds but may be more depending on the ADL setup).

Possible Problems

If the test above does not work then check the following:

a. The Dash Manager and Firmware Version must be 2.10F or higher.

b. Ensure that the latest ADL Firmware was sent to the ADL.

c. Ensure that the BR2 CAN Template is loaded in the Communications setup on one of the CAN tabs.

d. Ensure that the Beacon channel is ticked on in the CAN Communications template.

e. Ensure that the Correct *Mode* and *ID* have been entered in the ADL Lap Time and Number Setup screen.

3B. Diagnostic Channels

When using the CAN connection method the Receiver generates a number of information channels that can be used to check the performance.

The *Beacon Number* channel is useful for checking the *Mode* and *ID* setting of the Transmitter.

The *Valid Receptions* channel is useful for checking that the Receiver is receiving a good signal each time past the Transmitter. This should normally be between 10 and 21. If the number of receptions is low, it could be due to the Transmitter being placed too closely to another Transmitter.

See *Appendix D – BR2 CAN* Messages for details.

4. Check the Operating Range

Check that the beacon system operates at greater than 1.5 times the required distance. For example, if the beacon system must work at 10m then check that it works at a minimum distance of 15m.

If the range is short:

a. Check if the receiver is aimed through glass or acrylic sheet as this will affect the range. The range can be affected substantially, particularly if the glass is tinted or treated.

b. Check that the Transmitter and Receiver are aligned correctly, both must be within 5° of optimum (2° preferred).

c. Check that the LED on the Transmitter is green.

d. Check that the Receiver lens is clean (The rectangular black window)

e. Check that the Transmitter lens is clean (The round black window)

See Appendix A – Range Specification for more detail.

Appendices

Appendix A – Range Specification

Tested Range

The system should be tested to ensure that the actual range is at least 1.5 times the required range. Therefore, if the required range is 10m then a tested range of at least 15m is required.

The additional range allows a margin to ensure that a reliable signal is received under all conditions.

The range should also be checked with the engine running as severe interference from the ignition system may affect the range due to the interference rejection capability.

Specified Range

At lest 40m (130ft) subject to the conditions stated below.

Glass and Acrylic Sheet

If the receiver is aimed through tinted glass or tinted acrylic sheet (Plexiglass/ Perspex) the range may be reduced substantially. This needs to be checked for the particular installation by checking the operating range.

Clear glass or clear acrylic sheets are normally OK but the range should still be checked.

Alignment

The Transmitter and Receiver should be aligned within 2 degrees of optimum to achieve maximum range. Note that operation may be affected if the angle of either the Transmitter or receiver is more than 5 degrees from optimum.

Sunlight

The range is not affected by direct sunlight or any other ambient light levels including reflected light from other objects.

Rain

Rain will affect the range slightly. This is allowed for in the ‘Tested Range’ calculation above.

Note that water and dirt should be removed from the lenses of the transmitter and receiver to ensure optimum operation.

Transmitter Battery Voltage

The transmitter battery voltage does not affect the range as long as the Transmitter LED is green (Battery Voltage > 10.5V)

Transmitter Temperature

High temperatures in the Transmitter will affect the range slightly. This is allowed for in the ‘Tested Range’ calculation above.

Transmitter Age

The range will reduce slightly as the Transmitter ages due to a reduction in the Infrared diode efficiency.

Vehicle Speed

The vehicle speed does not affect the range (up to 300km/hr)

Appendix B – BTX Specifications

BTX (Beacon Transmitter)

Mating Connector

Connector: Hirschman CM06EA14S-7S

Electrical

Operating Voltage Range: 10.5V to 16V

Operating Current: 70mA typical

Environmental

Operating Temperature Range: -10C to 85°C Internal

Battery

An external battery is required.

Recommend Battery Type: Sealed lead acid

Recommended Capacity: 10Ahr or greater (approx 4 days operation)

Alignment

Within 5 degrees of optimum (preferably 2 degrees).

Minimum Spacing

The distance between adjacent transmitters must be greater than 6m (20ft)

Appendix C – BR2 Specifications

Mating Connector

Deutsch AS606-05SN-HE or ASL606-05SN-HE.

Electrical

Operating Voltage Range: 6.5V to 15V (8V from ADL/ECU Preferred)
(Reverse battery protected)

Operating Current: 80mA Typical

Environmental

Operating Temperature Range: -10C to 85°C Internal (70°C Ambient Typical)

Alignment

Within 5 degrees of optimum (preferably 2 degrees).

Switched Output

'Active Low', open collector type

Current Limited

The width of the output pulse represents the beacon transmitter number (tens and units only). From 0.2 sec to 1.7 sec depending on the number.

Appendix D – BR2 CAN Messages

The BR2 transmits a number of CAN messages to the ADL. These include messages that are only transmitted once per beacon event and periodic diagnostic messages that are transmitted 20 times per second. The messages are available as channels within the ADL.

Recommended Messages

The following messages are the most useful for normal operation and should be ticked on in the BR2 CAN template, and should be logged to establish that the beacon system is performing correctly.

Beacon

Required by the ADL to function correctly. This channel must always be ticked on.

BR2 CAN Diagnostic

Indicates if the BR2 is correctly communicating with the ADL via the CAN Bus.

Any number other than zero indicates that there is a problem. This could be due to a wiring fault, no Power at the BR2 or an internal problem with the BR2.

BR2 Diagnostic

Internal error code. Should be 0 (or 100), any other code indicates an internal problem with the BR2.

The error codes are:

10 Configuration Version Error – reload the configuration

11 Configuration CRC Error – reload the configuration

31 CAN HW Error

34 CAN Warn Error

42 Configuration Write Error – reload the configuration

100 Switched Output Error – The Switched Output is not connected

101 Excessive Receiver Noise - The BR2 is receiving too much electrical interference and may not work correctly.

Any other code indicates an internal problem

BR2 Valid Receptions

The number of valid beacon patterns received in 50ms. This gives a good indication of signal quality and signal strength. The maximum number that can be recorded is dependent on the beacon *Mode* and *ID*, but never exceeds 21. Normally at least 10 receptions should be received and the number of receptions should be consistent from Lap to Lap. Note that the number of receptions will reduce slightly at very high speed.

If the number of receptions is low, it could be due to the Transmitter being placed too closely to another Transmitter.

Sent once per Beacon event.

BR2 Beacon Number

The *Mode* and *ID* of the most recently detected beacon transmitter. If this channel is logged it will show all Beacon transmitters that the receiver detects.

BR2 Beacon Number = *Mode* x 100 + *ID*.

Sent once per Beacon event.

BR2 Beacon Count

Increases for each unique beacon detected. If this number jumps by more than one then a weak beacon was received that did not meet the criteria for a valid beacon which is at least two beacon patterns in a 50ms window.

Sent once per Beacon event.

Battery Voltage at BR2

The power supply voltage at the BR2

Must be in the range 6.5V to 15V (8V preferred).

Additional Messages

The following messages are useful for detailed diagnostics.

BR2 Detection Time

Gives an indication of the beacon beam width – this is the time between the first reception and last reception of the beacon pattern while in the detection window. This should normally be at least 25msec. The maximum is 50ms.

Sent once per Beacon event.

BR2 Detector Background

Indicates the average output of the receiver and is the signal level required to overcome background noise. This automatically increases in a noisy environment and decreases as ambient noise levels decrease. Typically around 2.5V

BR2 Latest Detector Peak

Indicates the peak amplitude reached for the beacon currently being received or 0 if no current beacon

BR2 Detector Peak

The peak amplitude of the beacon pulses detected by the receiver during the detection window at the time that the signal is considered a valid beacon signal.

Sent once per Beacon event.

BR2 Bias

This channel gives an indication of the total infra-red load on the detector. This is typically around 2.5V but may increase to around 9V with direct sunlight.

BR2 Trigger Threshold

The threshold currently in use for detecting beacon pulses. Typically around 0.05V and increases with vehicle noise. If this level gets too high then the range is reduced. An internal error is generated if this level is high enough to reduce the BR2 range below the minimum specified.

BR2 Secondary Threshold

Not used

BR2 Noise Bits

The number of noise pulses received so far. This may increase rapidly if an unknown IR source is transmitting towards the BR2 or a weak signal is being received.

BR2 Internal 10V

Internal 10V supply voltage.

The acceptable range is 9.8 to 11.2V

BR2 Internal 12V

Internal 12V supply voltage.

The acceptable range is 11.4 to 12.6V

Internal Temp BR2

The internal temperature of the BR2

Maximum 85 °C

BR2 Reset Source:

Normally 0 or 2, any other code indicates an internal problem.

BR2 Firmware Version

Reports the version of the firmware in the BR2.

Appendix E – BR2 LED Error Codes

2 Flashes: CAN Bus Error

Cannot communicate on the CAN bus. There may be a wiring error or there are no other devices connected to the can bus that are powered.

If the intention is to use the Switched Output rather than CAN Bus, then the BR2 should be configured for Switched Output operation using the Configuration program.

3 Flashes: Excessive Receiver Noise

The BR2 is receiving too much electrical interference and may not work correctly.

4 Flashes: Switched Output Error

The Switched Output is not working correctly. The output may not be connected or it may be shorted to ground or shorted to power.

If the intention is to use the CAN Bus rather than the Switched Output then the BR2 is incorrectly configured to use the Switched Output and must be changed to CAN using the BR2 Configuration program.

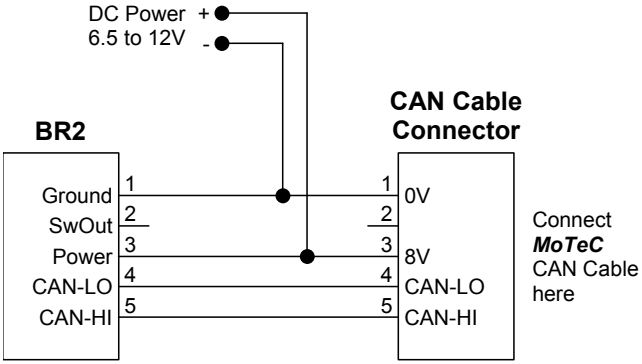
5 Flashes: Internal Error

One of the less common errors is present – the error code can be viewed via the ADL in the *BR2 Diagnostic* channel.

Appendix F – BR2 Configuration Loom

If the BR2 is not connected to the vehicle CAN Bus, then a standalone wiring loom is required to configure the BR2.

The wiring loom below provides power to the BR2 and to the ***MoTeC*** CAN Cable and allows the CAN Cable to communicate with the BR2.



BR2 Mating Connector

Deutsch AS606-05SN-HE or ASL606-05SN-HE

Appendix G - Transmitter Wiring

Mating Connector

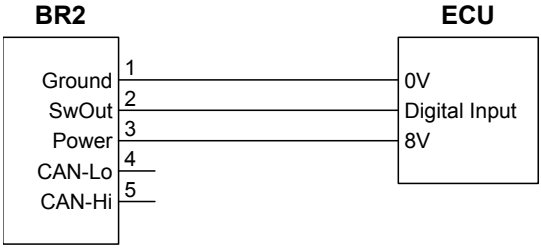
Connector: Hirschman CM06EA14S-7S

Connections

Pin Number	Wire Colour	Function
A	Black	Battery -
B		Not Used
C	Red	Battery +

Appendix H – BR2 Wiring (Switched Output)

The wiring shown below is used for the Switched Output connection method. This connection method is used for devices that do not support the CAN connection method.



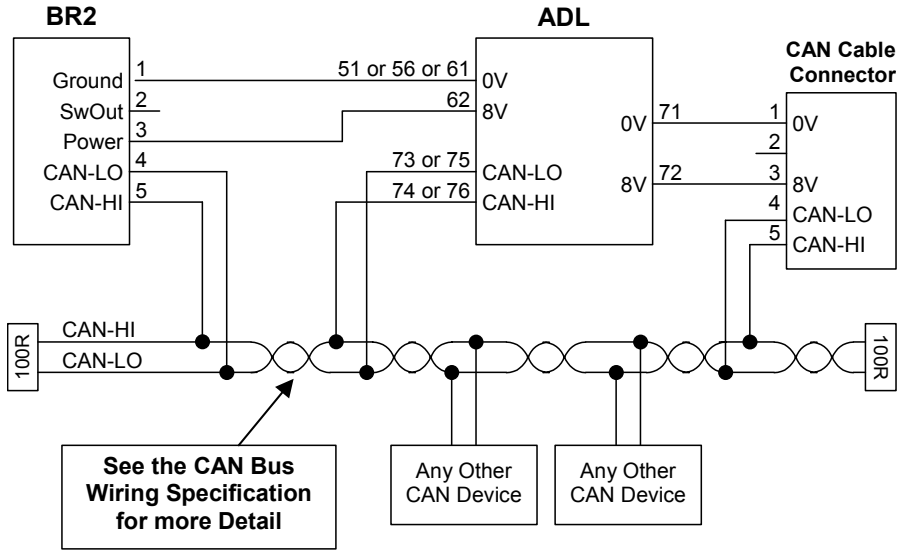
BR2 Mating Connector

Deutsch AS606-05SN-HE or ASL606-05SN-HE

Appendix J – BR2 Wiring (CAN)

The wiring below shows how to connect the BR2 to the ADL when using the CAN connection method.

For more detail on the CAN Bus wiring refer to *Appendix K – General CAN Bus Wiring*.



BR2 Mating Connector

Deutsch AS606-05SN-HE or ASL606-05SN-HE

Appendix K – General CAN Bus Wiring

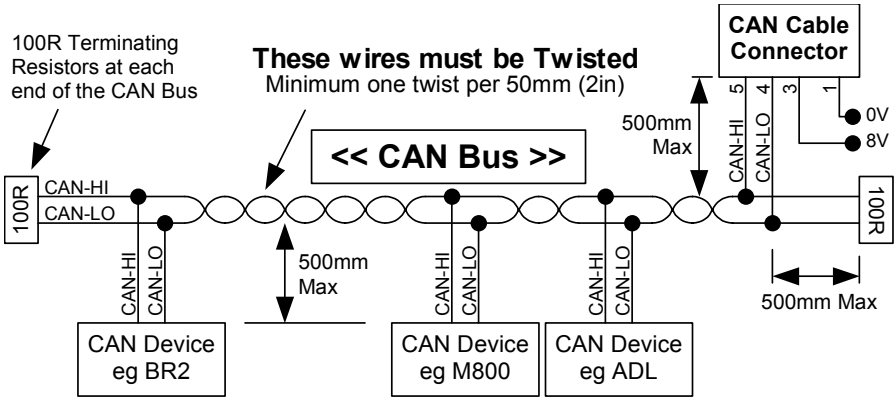
The CAN bus should consist of a twisted pair trunk with 100R (0.25Watt) terminating resistors at each end of the trunk.

The preferred cable for the trunk is 100R Data Cable but twisted 22# Tefzel is usually OK.

The maximum length of the bus is 16m (50ft) including the ***MoTeC*** CAN Cable (PC to CAN Bus Communications Cable)

CAN Devices (such as ***MoTeC*** ADL, BR2 etc) may be connected to the trunk with up to 500mm (20in) of twisted wire.

The connector for the CAN Communications Cable may also be connected to the trunk with up to 500mm (20in) of twisted wire and should be within 500mm of one end of the trunk. If desired two CAN Cable connectors may be used so that the ***MoTeC*** CAN Cable may be connected to either side of the vehicle. Both connectors must be within 500mm of each end of the trunk.



Short CAN Bus

If the CAN Bus is less than 2m (7ft) long or there is only one CAN device then a single termination resistor may be used at the opposite end of the cable as the CAN Cable connector.

Appendix L – BR2 Mounting Dimensions