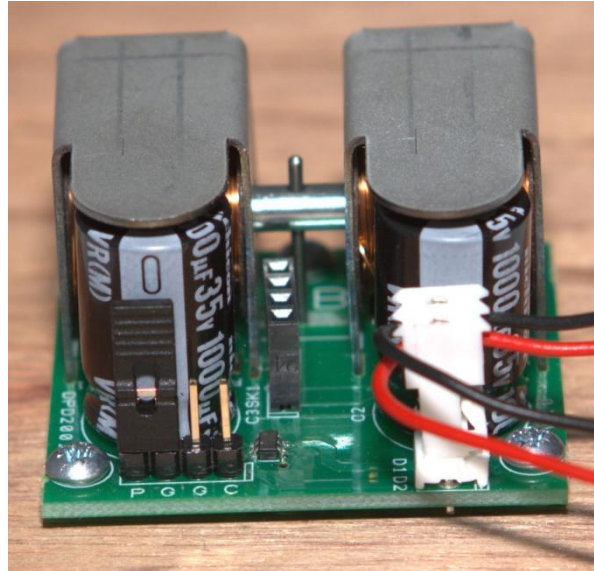




GEM DIGITAL POINT ACTUATOR

(Part no: DPD2001)

FULL USER GUIDE

GFB Designs - WE put YOU in control!

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WARNING

- The human body can generate static electricity which can damage electronic equipment – AVOID TOUCHING THE SURFACE OF THE GEM'S CIRCUIT BOARD!
- For INDOOR use only.
- The GEM is not suitable for use by children under 14 years of age unless supervised by an adult.

1) GETTING STARTED

Refer to fig. 1

The GEM will operate a model railway point (turnout), of up to O GAUGE size, using either *digital command control* (DCC) or “conventional” operation using a direct-current (DC) power supply.

As the GEM is an electro-magnetic unit, using solenoids, it requires NO mechanical adjustment. It is designed primarily for use with proprietary commercially available points which use an “over-centre” spring to hold the point *blades* against the *stock rails*.

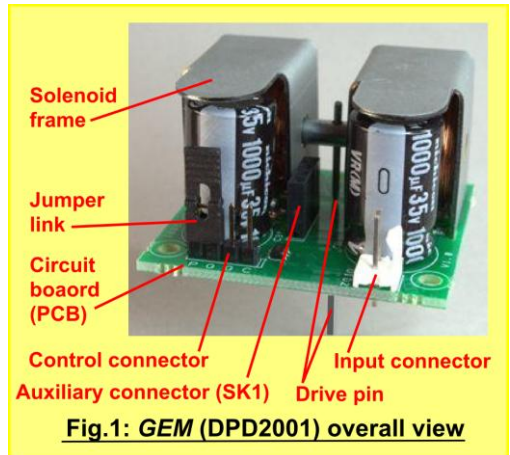


Fig.1: GEM (DPD2001) overall view

1.1) WIRING

Fig. 2 shows how to use the supplied connector. This is an *insulation displacement* (IDC) connector which plugs onto the *input* terminals of the GEM. IDC connectors do not require soldering, or wire stripping, BUT you must use the correct wire which is stranded insulated type, of 7/0.2mm size. This is stocked by GFB Designs – part number EW007215 (black; other colours are available).

Carefully press two wires into the connector as shown. Press repeatedly in all 6 positions until both wires are fully and evenly seated. A blunt tool - e.g. Allen key - no larger than 1mm dia. should be used taking care not to damage the metal blades of the connector. Alternatively, special tool HT110031 is available.

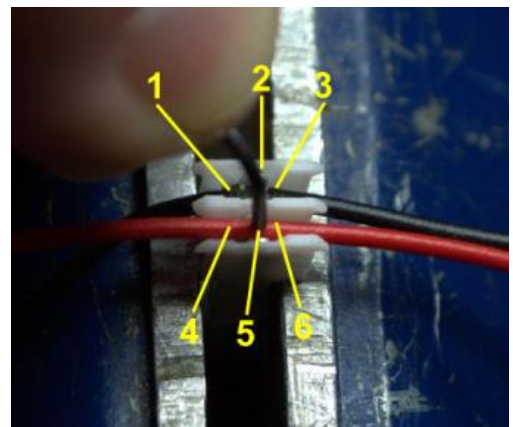


Fig. 2: Making connections

Wiring Information – (*Input and control* terminals are labelled with white on the PCB).

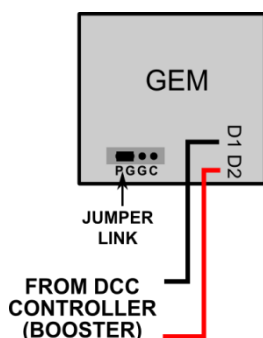
The <i>input</i> terminals are:	“D1”	- Power, or DCC , input
	“D2”	- Power, or DCC , input
The <i>control</i> terminals are:	“P”	- Power connection for the storage capacitors
	“G”	- Ground for the storage capacitors
	“G”	- Ground or <i>common return</i> for “C” input
	“C”	- Control input for manual override or “In-Situ Setup” (ISS)
The <i>auxiliary</i> terminals are:	“5”	- +5volts output for the RAS1202 accessory switch (if fitted)
	“B”	- Output indicating “point at position B ” (for LED or RAS1202)
	“A”	- Output indicating “point at position A ” (for LED or RAS1202)
	“G”	- Ground or <i>common return</i> for “A” and “B” outputs

The auxiliary terminals are not individually marked as their socket, “SK1”, is primarily intended for the RAS1202 relay accessory switch. They may, however, be used for other purposes as described on page 9.

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The GEM will draw very little current from your layout – no more than 20mA (0.02A) when *idling* and less than 200mA (0.2A) for less than 2 seconds after a point state change.

Fig. 3 shows a basic configuration for operation by DCC where the point state (i.e. normal/closed or reversed/thrown) is selected by sending accessory instructions from your DCC *command station*.



Note that several GEMs can be connected to one pair of wires running around your layout. This is known as a “bus” arrangement.

Fig. 3: Wiring for basic DCC control

Fig. 4 shows operation **without DCC**, using DC power and a *double-pole/double-throw (DPDT)* switch. In this case, the point state is determined by the *polarity* of the DC power supply – if the “D2” terminal is *positive*, the GEM will drive towards “A” (marked on the PCB in white) and it will drive to “B” when “D2” is *negative*.

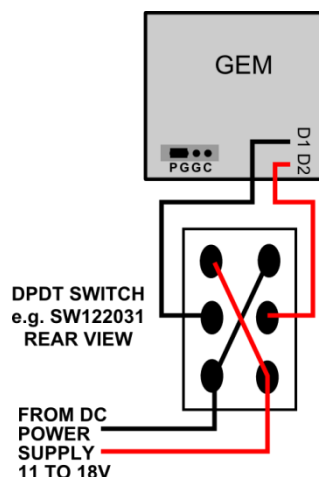


Fig. 4: Wiring for operation without DCC

1.2) INSTALLING THE GEM – see also notes on page 5

The GEM is usually mounted to the underside of the *track bed*, directly underneath the point, using three 3mm diameter wood screws (supplied) as shown in fig. 5a. This provides the simplest mounting arrangement with the drive pin engaging directly with the tie bar on the point as shown in the sectional side view – fig.5b.

The three supplied plastic spacers must be positioned as shown in fig. 5. These provide stability and ensure that no load is put on the solenoid frames as the mounting screws are tightened.

WARNING

- The GEM **MUST NOT** make contact with any electrically-conductive parts!
- **DO NOT OVERTIGHTEN** the mounting screws. **Under no circumstances must the circuit board be flexed or distorted!!**

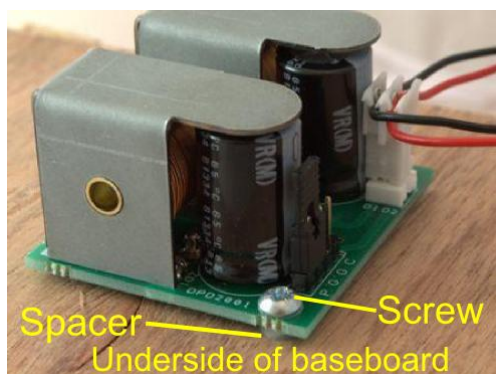


Fig.5a: GEM Installation – underside view

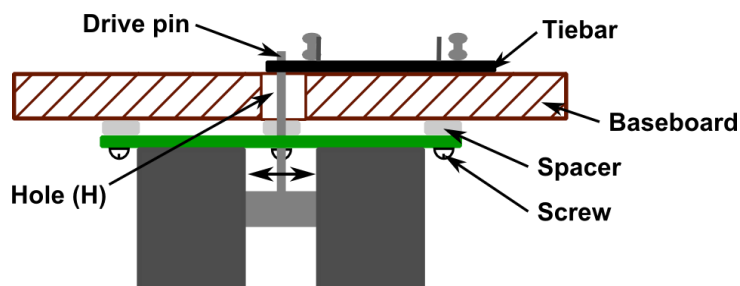
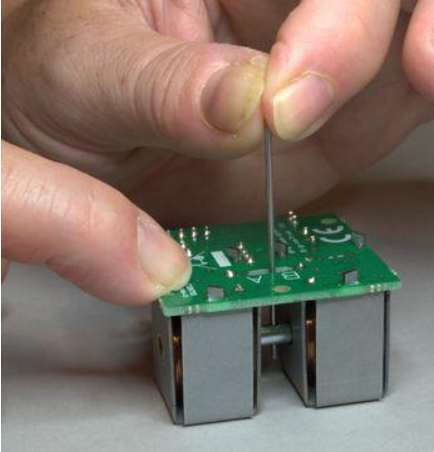


Fig.5b: Sectional view through point & baseboard

Installation Tips

We recommend that the following advice and photographs are followed to ensure trouble-free installation and operation:-

A) Centre the drive pin.....



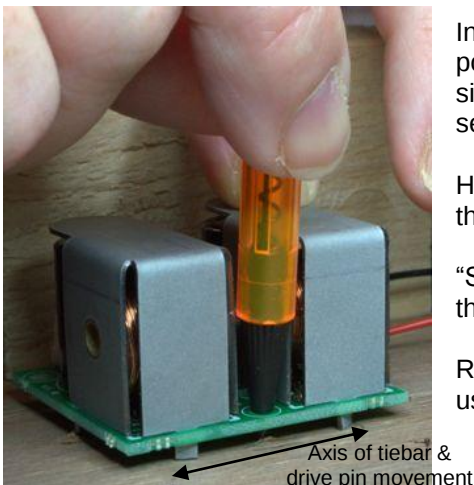
Move the drive pin to within about a millimetre of the centre of its slot. The pin will move freely.

Try to keep the pin centred as you position the *GEM* at the start of “stage (B)”.

Centring the drive pin ensures that there is adequate movement available in both directions.

Ensure that the baseboard has a hole or slot cut under the point tiebar and that the *GEM*'s drive pin has sufficient clearance within this hole.

B) Align the *GEM* and drill the mounting holes.....



Insert the drive pin through the slot in the baseboard and then into the point *tiebar*. Once the drive pin is engaged in the tiebar, move the *GEM* sideways slightly in the opposite direction to which the point is currently set (about 1mm for N gauge, 1.5mm for OO or 2mm for O).

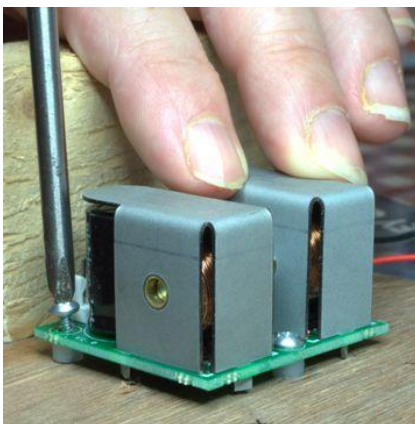
Hold the *GEM* against the baseboard ensuring that it is aligned squarely to the line of the point tiebar (see picture).

“Spot through” the three mounting holes with a pencil, as shown, to mark their positions on the baseboard.

Remove the *GEM* and drill a *pilot hole*, at the centre of each pencil mark, using a 2.0mm drill bit.

NOTE: The drive pin should be cut to length at this stage, allowing an extra 1mm. This provides a slight protrusion past the top surface of the point tiebar and takes into account the difference in thickness between the solenoid frame securing tabs and the plastic spacers.

C) Install and secure the *GEM*.....



Remove the unit from the baseboard and clean away any sawdust or other debris.

Re-install the *GEM*, adding the plastic spacers, and secure in position using the three supplied 3mm diameter woodscrews. Do not over-tighten the screws.

NOTE – The *GEM* may be mounted the opposite way round to that shown if your baseboard structure, or track layout, demands it. You can change the *operating sense* of the unit as described on pages 7 and 12.

Don't forget the spacers !!

2) OPERATING

2.1) DCC OPERATION

This section assumes that you have a DCC system – including a *command station*, *booster* and *decoder programmer* (often combined in one unit) – which is fully compliant with the *National Model Railroad Association* (NMRA) DCC Standards. As all DCC systems vary in their exact operating methods, please read the following instructions in conjunction with your DCC system manual.

Initial testing

With the unit wired as shown in fig. 3, turn on your DCC controller.

Refer to your DCC system manual and perform the following actions:-

- Select *accessory* (“point”/“switch”/“turnout”) NUMBER 1 on the controller.
- Send a single “POINT NORMAL” (or “turnout”/“switch” “closed”/“on”) command.

The GEM will snap its output pin to the “A” mark on the PCB. If the unit is already installed, then the point blades should be fully driven towards “A” so that one blade is closed firmly against its associated stock rail.

See the “Troubleshooting” section on page 18 if the above action does not occur.

Changing the point address

We have provided a simple method for basic setup of the GEM which avoids programming *configuration variables* – we call this “*in-situ setup*”. To set the address of the point, proceed as follows:-

- Connect the GEM to the main or “track” output of your DCC controller (NOT the programming output) – see fig.3.
- Turn on your DCC controller.
- Move the jumper link on the GEM from the “P”/“G” control pins to the “G”/“C” pins – wait about 2 seconds.
- On your DCC controller, select the *accessory* (“point”/“switch”/“turnout”) address that you wish the point to be allocated to. This can be any number between 1 and 2044 (or as may be restricted by your DCC system).
- Send a “POINT NORMAL” (or “closed”/“on”) command.
- Move the jumper link back to the “P”/“G” pins.

The GEM will have “learnt” your chosen address. NOTE that you must use an accessory (“point”/“switch”/“turnout”) **operating** command during the above process – the programming mode on your DCC controller is not required and must not be used for *in-situ setup*.

Controlling the point

In order to control the point state, when operating your layout, perform the following actions:-

- On your DCC controller, select the required *accessory* (“point”, “switch” or “turnout”) address.
- Send a “POINT NORMAL” (or “closed/on”) command to drive in the “A” direction.

Or:-

- Send a “POINT REVERSED” (or “thrown/off”) command to drive in the “B” direction.

NOTE: When power is removed, the GEM may drive in the “A” direction. If this is not desirable, then “non-DCC” mode must be disabled as described under “Setting Operating Modes and Options (CV2)” on page 12.

Reversing the operating sense

Depending upon whether your point is left or right hand, and depending upon the orientation of the GEM, you may need to reverse the *operating sense*. This means that a “POINT NORMAL” (or “closed”/“on”) command will drive the unit in the “B” direction and a “POINT REVERSED” (or “thrown”/“off”) command will drive in the “A” direction. To achieve this, using *in-situ setup*, proceed as follows:-

- Connect the GEM to the main or “track” output of your DCC controller (NOT the programming output), as shown in fig.3.
- Turn on your DCC controller.
- Move the jumper link on the GEM from the “P”/“G” control pins to the “G”/“C” pins – wait approximately 2 seconds.
- On your DCC controller, select the *accessory* (“point”, “switch” or “turnout”) address that you wish the point to be allocated to. This can be any number between 1 and 2044 (or as may be restricted by your DCC system).
- Send a “POINT REVERSED” (or “thrown”/“off”) command.

Move the jumper link back to the “P”/“G” pins.

2.2) NON-DCC OPERATION

Provided that the GEM has not had the configuration variable CV2 changed under DCC programming, it will operate using “traditional” power, without DCC, as follows:-

Power Supply

As shown in fig. 4, a power supply must be connected to the “D1” and “D2” terminals through a double-pole-double-throw (DPDT) switch as shown in fig. 6. The characteristics of the power supply are:-

- It must produce *smooth direct current* (DC).
- Normal voltage between 11 to 18 volts. DO NOT EXCEED 25
- VOLTS UNDER ANY CIRCUMSTANCES !!
- Available current 0.15amp (150mA) for each GEM supplied.

Examples of suitable power sources are:-

- GFB Designs – part number PS115017
- “Maplin Electronics” – stock code L48BL.
- “Rapid Electronics” – stock code 85-2903.

Examples of suitable switches are:-

- GFB Designs – part number SW122031.
- “Maplin Electronics” – stock code FH04E.
- “Gaugemaster” – stock code E029.

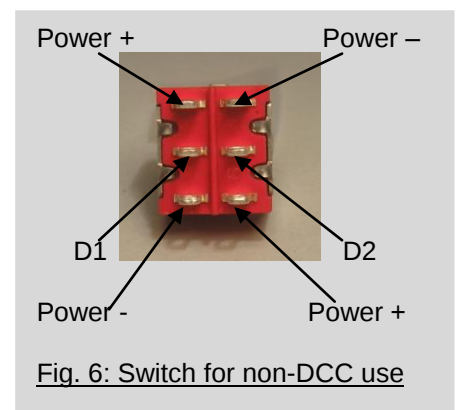


Fig. 6: Switch for non-DCC use

Point Control

Simply change the switch position and the GEM will drive to the opposite state. You can reverse the “D1”/“D2” connections from the switch, or change the orientation of the switch in your control panel, if you need to reverse the operating sense.

Consult the “Troubleshooting” section of this guide (page 18) if point control can not be satisfactorily obtained.

NOTE: When power is removed, the GEM may drive to the opposite position but it will “follow” the switch setting when power is re-applied.

3) ADDITIONAL FEATURES

The *GEM* incorporates a DCC accessory decoder as defined by the NMRA. It obtains power and control information from your DCC booster via the “D1” and “D2” terminals as indicated in fig. 3. Most DCC accessory decoders will drive up to four points (or other devices) but, as the *GEM* is a completely self-contained unit, its internal decoder is dedicated to a single point.

The *GEM* will “recognise” a valid DCC signal when supplied to the “D1” and “D2” terminals and will run under DCC commands. *Non-DCC* mode is automatically entered when the unit is supplied with direct current (DC) and the operation is then as described on page 7. However, non-DCC mode can be disabled as explained in the section on “CV setting” (page 12).

Some features of the *GEM* work in both DCC and non-DCC modes whilst others are applicable to DCC operation only. All additional features are described in the following sections.

3.1) Adding the RAS1202 Accessory Switch for “Live Frog” Switching

Note that the use of the frog switching feature is optional and depends upon the type of points in use. Commercially-available (“ready to run”) points have either *insulated* or *conductive* frogs and it is generally considered preferable to use the conductive, or “live”, type for improved running reliability (especially with locomotives that have a limited number of electrical pick-ups). Fig.7 shows how the *GFB Designs RAS1202* accessory switch can be fitted to the *GEM* (plugged in to the “SK1” auxiliary connector) in order to provide power to live frogs. Please refer to the RAS1202 user guide for further details.

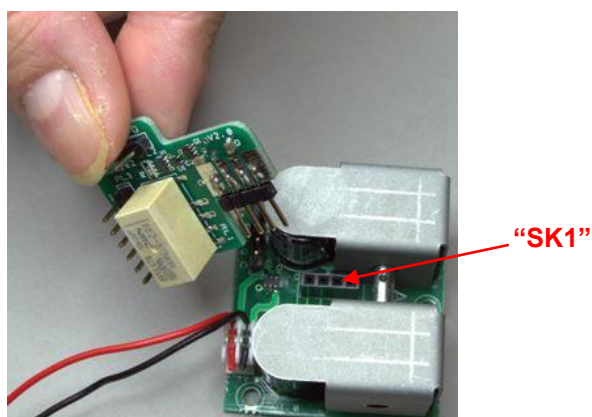


Fig.7a: Fitting the RAS1202 accessory switch

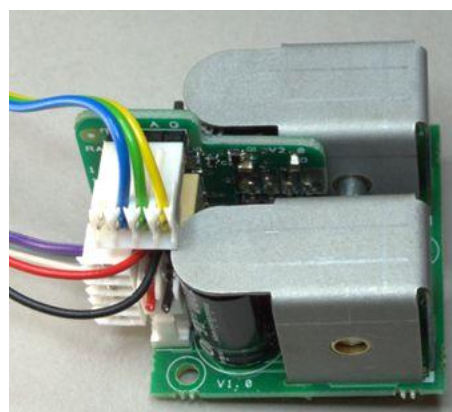


Fig.7b: Installed RAS1202 with wiring

Some commercially-built “live frog” points have their blades and frog wired together so that power is conducted to the frog when a blade makes contact with its respective stock rail. We recommend two modifications to these points – as shown in fig.8 below - for best results:-

- Electrically isolate the frog. This prevents short-circuits occurring if the movement of the point blades is not properly synchronised with the changing state of the accessory switch.
- Wire each point blade to its respective stock rail. This ensures a good power feed to the blades without having to rely on their contact with the stock rails.

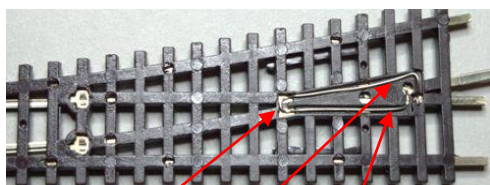


Fig.8a: Unmodified point

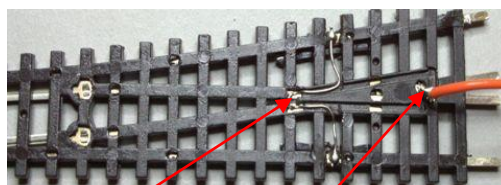


Fig.8b: Modified point

NOTE that such work is likely to invalidate the point manufacturer's warranty. Whilst we recommend it, to enhance performance, GFB Designs can not be held responsible for any related consequences.

Point Frog Wiring

Fig.9 below shows how to connect a live point frog to the relay on the RAS1202 (IDC connectors are supplied with the RAS1202).

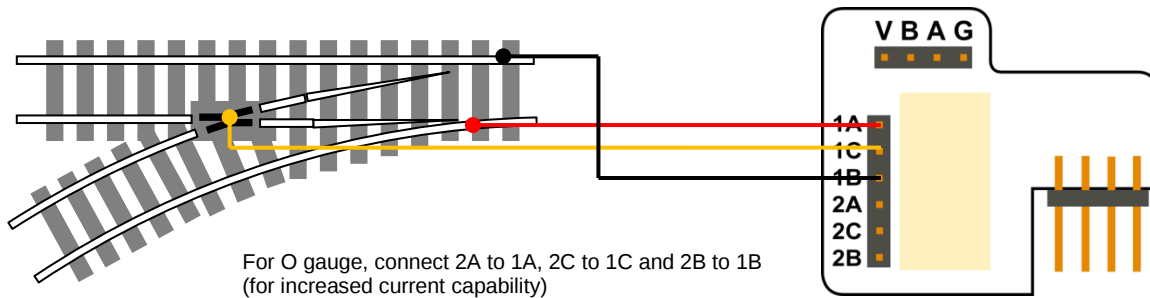


Fig.9: Live Frog Wiring to the RAS1202

3.2) Indication (“A” & “B”) Outputs

The “A” and “B” outputs are intended to drive *light emitting diode* (LED) indicators which can be mounted on a control panel or track diagram in order to indicate point state. Fig.10 shows the required wiring.

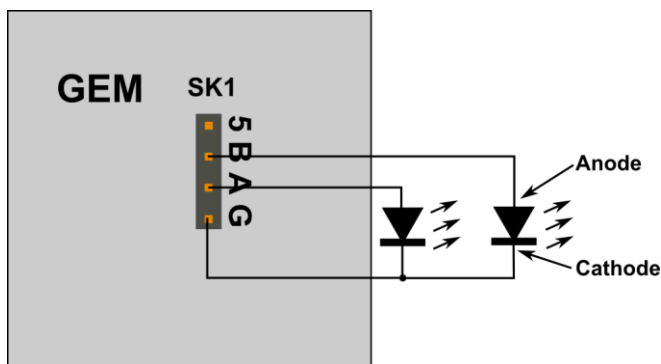


Fig.10a: Connection of LEDs for point state indication.

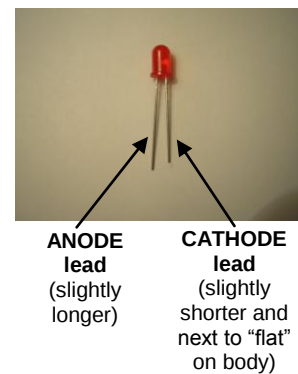


Fig.10b: A typical LED.

NOTE:-

- The “A” and “B” outputs will only supply a limited current (around 8 to 9mA).
- The current limiting resistors required for LEDs are built in to the GEM.
- DO NOT INTERCONNECT THE “G” TERMINALS BETWEEN TWO OR MORE GEMs.

The “A” LED will be on if the point is driven to the “A” mark on the GEM’s circuit board and the “B” LED will be on if it is driven to “B”.

The GEM is set to ORIGINAL operating sense when supplied but the unit can be changed, to ALTERNATIVE operating sense, under ISS – see page 7 – or under DCC programming – see page 12.

In ORIGINAL operating sense:-

- Point NORMAL state corresponds to the unit being driven in the “A” direction.
- Point REVERSED state corresponds to the unit being driven in the “B” direction.

In ALTERNATIVE operating sense:-

- Point NORMAL state corresponds to the unit being driven in the “B” direction.
- Point REVERSED state corresponds to the unit being driven in the “A” direction.

3.3) Indication (“A” & “B”) Outputs with the RAS1202 accessory switch in use

If you are using the RAS1202 accessory switch, the “A” and “B” terminals on the “SK1” connector will no longer be accessible. Instead, they are brought out on the auxiliary connector of the RAS1202 as shown in fig.10c opposite:

3.4) Other uses for the RAS1202 relay:-

The RAS1202 relay connector gives access to two sets of changeover contacts, each rated at 2amps. In addition to point frog switching, they could – for example - be used for.....

- Power isolation on a siding, or branch road, when the point is set “against” it.
- Route “feather” indication on a colour-light signal.
- Semaphore signal control – e.g. by switching the power input polarity to a *GFB Designs IMP* servo controller.

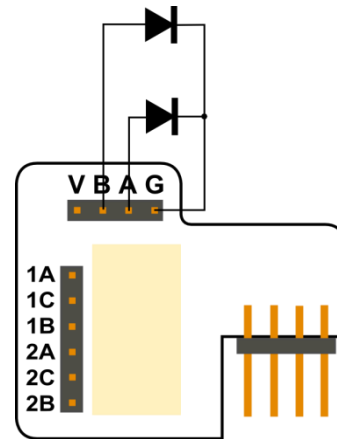


Fig.10c: Indicator LEDs with the RAS1202

3.5) Remote control (“C”) input

The “C” input on the auxiliary connector can be used to remotely operate the *GEM* independently from DCC commands or DC polarity. Fig.11 below shows how to connect a *normally-open* push-button switch, between “C” and “G”, in order to achieve this.

Pressing and releasing the push-button switch will override the last DCC, or DC, command sent and will change the point setting to its opposite state.

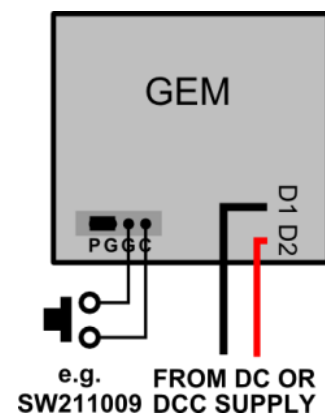


Fig.11: Adding a push-button switch for remote point operation

NOTE:-

- DO NOT INTERCONNECT THE “G” TERMINALS BETWEEN TWO OR MORE *GEM*s.
- The switch must be a **momentary, normally-open** type (i.e. spring-loaded to the OFF position).
- Operation from the “C” input can be disabled by changing **CV2** – see “CV Setting” below (page 12).

4) ADDITIONAL DCC FEATURES

4.1) CV SETTING (with a DCC programmer)

Configuration variables (CVs) are special numbers stored within the *GEM*'s memory. The format is defined by the NMRA Standards. The *address*, operating modes and options of your point actuator can be changed by setting CVs **1, 2, 9 and 33 to 80** with the values indicated below – refer to your DCC system manual for details on how to program CVs. Once programmed, a CV will retain its value even when power is removed from the *GEM*.

Note that the *GEM* will normally have CVs changed in *service mode*. This means that its “D1” and “D2” terminals should be connected to the *programming track* output of your DCC controller (or programmer). CVs can also be changed in *operations mode*, with the *GEM* connected in your layout, BUT only if you have a DCC controller that is capable of sending *operations mode accessory programming* instructions. Currently most DCC systems cannot do this (their *operations mode CV access* capability is restricted to locomotives).

The NMRA has defined four methods of changing CVs in service mode: i.e. *address only*, *register*, *paged* and *direct*. You do not need to understand how these work – you simply need to be aware that the *GEM* supports all four techniques. Refer to your DCC system manual to determine the most appropriate method. (The *GEM* automatically responds to whichever CV access instructions are received by it).

(Earlier versions of the NMRA standards specified CVs in the range 513 to 1024 for accessory decoders. For “backwards compatibility” the *GEM* interprets CVs 513 to 1024 as CVs 1 to 512)

NOTE: In order to obtain correct read back and acknowledgement of CV values on your programmer or controller, the *GEM*'s jumper link must be removed from the “PIG” pins (then replaced for point operation).

“Read only” CVs (5, 7 & 8)

The following CVs cannot be changed. They are required by the NMRA Standards and they contain data on the *GEM*.

CV (or REGISTER) NUMBER	VALUE	DATA (meaning of value)
29 (Register 5)	192	ACCESSORY decoder – OUTPUT address method (single point) – BASIC addressing (“simple” accessory control) – no bi-directional communication
7 (Register 7)	10	Software version (currently V1.1 at 22 Sep 2014)
8 (Register 8)	46	Manufacturer I.D. (<i>GFB Designs</i>)

Changing The Point Address (CVs 1 & 9)

By re-programming *configuration variables* (CVs) **1** and/or **9** the *address* of the point can be changed.

Refer to your DCC system manual for details on how to program CVs. The programmer – or the programming output of a combined command station and programmer – should be connected to the “D1” and “D2” terminals of the *GEM*.

NOTE: Some DCC system instructions refer to decoder *registers* rather than *CV numbers*. In this case, the point address is set in **register 1** and a value between 1 and 255 (inclusive) is, again, allowed.

The *GEM* can be set to any address between **1** and **2044** inclusive. Note, however, that the *GEM* will ALWAYS respond to addresses 2041, 2042, 2043 and 2044 regardless of the values set in CVs 1 and 9. These special addresses are known as *broadcast addresses* as recommended by the NMRA.

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To set the address between 1 and 255 inclusive (recommended for simplicity):-

- Ensure that **CV9** is set to **0** (as supplied – *default* value).
- Set **CV1 (register 1)** to the **required address**.

Example: For address 78 - CV9 = 0; CV1 = 78

To set the address between 256 and 2044 inclusive (more complex – NOTE: the register method can not be used to set addresses in this range):-

- Working in WHOLE NUMBERS, divide your required address by **256**.
- Set **CV9** to the **whole number result** of the division.
- Set **CV1** to the **remainder** from the division.

Examples:	For address 256:	$256 / 256 = 1$ remainder 0	so....	CV9 = 1; CV1 = 0
	For address 257:	$257 / 256 = 1$ remainder 1	so....	CV9 = 1; CV1 = 1
	For address 511:	$511 / 256 = 1$ remainder 255	so....	CV9 = 1; CV1 = 255
	For address 1453:	$1453 / 256 = 5$ remainder 173	so....	CV9 = 5; CV1 = 173
	For address 1792:	$1792 / 256 = 7$ remainder 0	so....	CV9 = 7; CV1 = 0

Setting Operating Modes And Options (CV2)

To set the value of CV2 (register 2), perform the following calculation:-

- Start with a value of **0** (zero).
- Add: **0** to **disable** the “C” input
or: **1** to **enable** the “C” input
- Now add: **0** to **disable non-DCC** mode
or: **2** to **enable non-DCC** mode
- Now add: **0** to select **original operating sense** – i.e. a NORMAL command drives to “A”
or: **128** to select **alternative sense** – i.e. a NORMAL command drives to “B”
- Set **CV2 (register 2)** to the value you have calculated.

For example:-

The GEM is supplied with CV2 set to a value of **3** (the *default* value). This configures the unit as follows:-

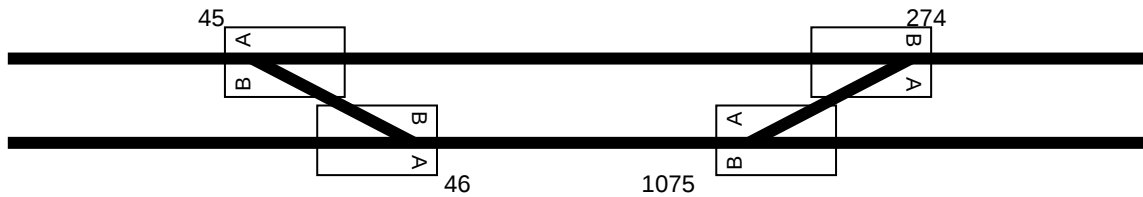
Control “C” input enabled	(1)
Non-DCC mode enabled	(+ 2 = 3)
Original operating sense	(+ 0 = 3)

Now suppose that you wish to change to **alternative** operating sense and **disable** remote control from the “C” input. CV2 needs to have a value of **130** so that:-

Control “C” input disabled	(0)
Non-DCC mode enabled	(+ 2 = 2)
Alternative operating sense	(+ 128 = 130)

4.2) Route Setting Using Secondary Addresses (CVs 33 to 80)

Consider the following track configuration with each point having its own GEM with addresses of 45, 46, 274 and 1075. Assume that the GEMs are orientated as shown:-



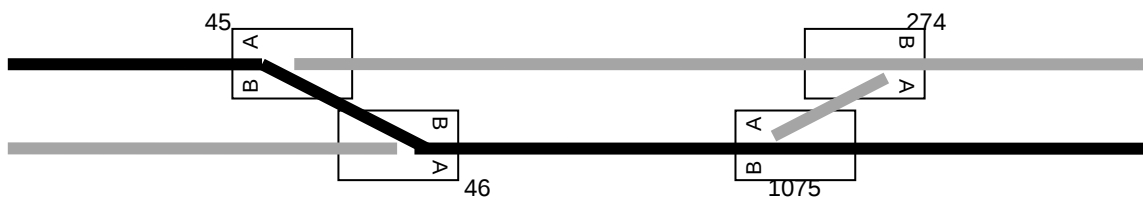
Now, if both roads are bi-directional, then the following routes can be set up:-

Route 1:-



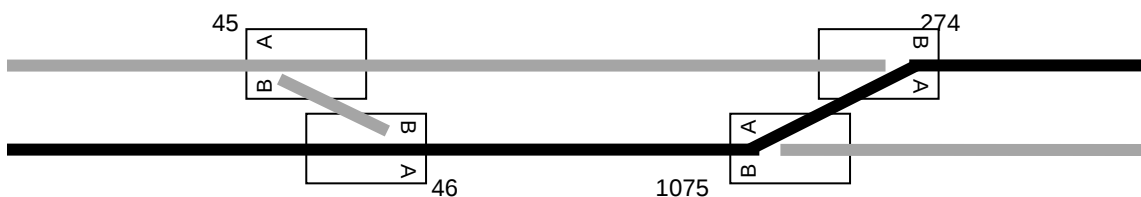
To set this route, the point states must be: **45 to B; 46 to B; 274 to A; 1075 to A.**

Route 2:-



To set this route, the point states must be: **45 to A; 46 to A; 274 to A; 1075 to A.**

Route 3:-



To set this route, the point states must be: **45 to B; 46 to B; 274 to B; 1075 to B.**

Route 4:-



To set this route, the point states must be: **45 to A; 46 to A; 274 to B; 1075 to B.**

(Now see the next page to program the four GEMs for these routes)

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How to set the secondary addresses:-

To program the route-setting shown above on page 11, the GEMs need to have their CVs set as follows:-

<u>Unit 45:-</u>	<u>Unit 46:-</u>	<u>Unit 274:-</u>	<u>Unit 1075:-</u>	
CV1 = 45	CV1 = 46	CV1 = 18	CV1 = 51	
CV2 = 131	CV2 = 131	CV2 = 3	CV2 = 3	
CV9 = 0	CV9 = 0	CV9 = 1	CV9 = 4	
CV33 = 1	CV33 = 1	CV33 = 129	CV33 = 129	(Route address 1)
CV34 = 130	CV34 = 130	CV34 = 130	CV34 = 130	(Route address 2)
CV35 = 3	CV35 = 3	CV35 = 3	CV35 = 3	(Route address 3)
CV36 = 132	CV36 = 132	CV36 = 4	CV36 = 4	(Route address 4)
CV37 = 0	CV37 = 0	CV37 = 0	CV37 = 0	

(All CVs 38 to 80 will be set to zero unless previously programmed for other routes)

With these settings:-

- Each point will respond INDIVIDUALLY to its primary address.
- The values of CV2 ensure that NORMAL commands correctly set individual points “straight through”.
- To set a route, send a REVERSED command to the address of the relevant route – i.e. 1, 2, 3 or 4.

How it works.....

The GEM will not only respond to the **primary address**, set in CV1 and CV9, but also to any **secondary address** set in CVs 33 to 80. Up to 48 secondary addresses may be set and EACH secondary address has its own *operating sense* assigned to it.

- Secondary addresses can have a value of between **1 and 124**.
- A value between 1 and 124 (set in any of the CVs 33-80) will set the **original** operating sense for *that particular address*.
- To set the **alternative** operating sense for a particular secondary address, the value of that address is **increased by 128**.

For example:-

Suppose the point needs to respond to addresses **10, 32 and 119** in addition to its primary address. Suppose also that we require the **original** operating sense for address **32** and the **alternative** operating sense for addresses **10 and 119**. CVs 33 to 36 should be set as follows:-

CV33 = 138	(10 + 128)
CV34 = 32	
CV35 = 247	(119 + 128)
CV36 = 0	

When the GEM receives a valid *accessory* instruction it compares the *received* address with its *own primary* address, stored in CVs 1 and 9. The instruction will be executed if these addresses match, otherwise a search is performed on the *secondary* addresses, CVs 33 to 80, in order (33, 34, 35, , 79, 80).

The search through CVs 33 to 80 stops in any of the following circumstances:-

- A match is found between the received address and a stored secondary address (*the instruction will be executed*).
- As soon as a value of 0 (zero) is found in any of the CVs 33 to 80 (*instruction will be ignored*).
- All 48 secondary addresses (i.e. all CVs 33 to 80 inclusive) have been checked (*instruction ignored*).

THEREFORE, A SERIES OF SECONDARY ADDRESSES SHOULD ALWAYS BE PROGRAMMED, WITHOUT GAPS, STARTING WITH CV33 AND ENDING WITH A VALUE OF ZERO.

Note that the GEM is supplied with CVs 33 to 80 all set to zero.

4.3) “In-Situ” Setup (ISS) In Detail

DCC accessory programming is normally performed in *service mode* where ALL decoders will respond to programming commands, irrespective of their current address. This means that ANY decoder connected to the DCC source would be re-programmed along with the particular unit being “targeted”! The *GEM* can be programmed in *operations mode*, which avoids this problem, BUT only if your DCC controller supports operations mode accessory programming (most systems only allow operations mode programming for locomotives).

In-Situ Setup overcomes this inconvenience by providing a means of selecting/changing primary and secondary point addresses, along with setting the operating sense for each address - without using a DCC programmer - and without having to disconnect or remove the *GEM* from your layout.

To enter *In-Situ Setup* mode, the “C” and the “G” terminals must be connected together for at least **two seconds** and the unit will stay in ISS mode whilst “C” and “G” are interconnected. Once the connection is broken between “C” and “G”, the *GEM* will revert to normal operating mode. Either a switch (e.g. a push button switch normally used for remote operation) or the supplied jumper link may be used for the connection.

If you are using point state indication, as described on page 9 or 10, then the LEDs connected to the “A” and “B” outputs provide valuable “status” indication during In-Situ Setup. The process can still be performed without the indicators, however, but no acknowledgement of each stage of the process will be provided.

Once in In-Situ Setup mode, the addresses and operating senses are set by issuing standard DCC accessory OPERATING commands from your controller. The “D1” and “D2” terminals, therefore, need to be supplied from the “main” or “track” output from your DCC system (as will be the case when the unit is installed on a DCC layout) NOT the programming output.

NOTE ALSO: If the supplied jumper link is used to control In-Situ Setup, it must be returned to the “P”/“G” terminal pins in order enable point operation!

The *In-Situ Setup* process works as follows:-

- Connect “C” to “G”.
- After 2 seconds, the “A” and “B” LEDs will start flashing rapidly – the *GEM* is now in ISS mode.
- All secondary addresses (CVs 33-80) are automatically reset to zero.
- The *GEM* is now waiting to setup its **primary** address. Using your DCC controller, send a “**point change**” command to the address that you wish to set as the primary address. The *operating sense* for this address is set according to whether a “normal” (“closed”/“on”) or a “reversed” (“thrown”/“off”) command is sent.

Example 1: To set the primary address to **10**, with the **original** operating sense, send a point **normal (closed/on)** command to address **10**.

The “B” LED will go OFF for about one second to acknowledge the setting.

Example 2: To set the primary address to **1789**, with the **alternative** operating sense, send a point **reversed (thrown/off)** command to address **1789**.

The “A” LED will go OFF for about one second to acknowledge the setting.

This operation automatically sets CVs 1, 9 and 2 accordingly and both LEDs then continue flashing.

- The *GEM* is now waiting to setup its first **secondary** address (i.e. CV33). This is performed in the same manner to the primary address – i.e. send a “point change” command to the address (**between 1 and 124**) that you wish to set as a secondary. The operating sense, *for this specific address*, is set according to whether a normal (closed/on) or a reversed (thrown/off) command is sent.
- Acknowledgement of the setting is indicated, again, by a brief extinguishing of either the “A” or the “B” LED (according to whether a normal or reversed instruction was sent). CV33 is now set.

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- Repeat the above operation for each subsequent secondary address (up to a further 47) that you wish to set. CVs 34, 35, 36, etc. will be set in turn, until you stop sending point instructions.
- Finally, remove the “C”-“G” connection. The LEDs will stop flashing, indicating that the *GEM* is back in normal operating mode.

5) BASIC DOs AND DON'Ts

DO.....

- Read and follow these instructions carefully.
- Handle the unit by the solenoid frames or the circuit board edges only.
- Mount the unit on an INSULATING surface.
- Check all wiring carefully before applying power to the unit.
- Work within any electrical limitations stated in these instructions.
- Contact *GFB Designs* for advice if you are unsure of ANY technical issues.

DON'T.....

- Excessively handle the unit.
- Touch the surfaces of the circuit board.
- Attempt to use the *GEM* where moisture is present.
- Over-tighten the mounting screws.
- Crush or over-stress any wires (e.g. by stapling them to your baseboard).
- Apply a voltage between the "D1" and "D2" inputs greater than 24 volts.
- Apply a voltage between the "G" and the "C" inputs greater than 5 volts.
- Apply any power source to the "A" or "B" output(s).
- Attempt to dismantle or repair the unit yourself.

6) GEM TECHNICAL SPECIFICATIONS

(hardware version 2.0 & software version 1.1)

DESCRIPTION:	A fully integrated electro-magnetic model railway point actuator, incorporating a DCC decoder and capacitive discharge unit – compliant with applicable parts of the National Model Railroad Association Standards S-9.1, S-9.2, S-9.2.1, S-9.2.2, S-9.2.3 and S-9.2.4.
CURRENT CONSUMPTION:	No greater than 20mA idling and less than 200mA operating.
INPUTS - "D1" & "D2":	Accept DCC (compliant with NMRA S-9.1) or DC. Voltage range: 11.0V to 25.0V peak (abs. max. 27V peak).
- "C":	"Active low" logic input. Requires a "potential-free" switch to "G" which must sink at least 0.3mA (Attains +5V relative to "G" when open-circuit)
OUTPUTS - "5":	+5volts power for accessories (mainly intended for RAS1202 relay accessory switch. Max 80mA.
- "A" & "B":	Point state indication outputs. Voltage sources with 330ohm series resistor. 0V relative to "G" when OFF; +5V (open circuit) relative to "G" when ON (approx. 15mA short-circuit).
DCC ADDRESSING MODES:	BASIC mode only – OUTPUT address method (see NMRA S-9.2.1).
CV PROGRAMMING MODES:	SERVICE and OPERATIONS MODES supported. In service mode ADDRESS ONLY, REGISTER, PAGED and DIRECT methods may be used.
DRIVE PIN TRAVEL:	Max. 3.5mm either side of centre. Linear movement with +/- 1mm perpendicular play.
SIZE & WEIGHT:	43.0 X 39.8 X 26.7mm ± 0.5mm (overall, exc. drive pin). Weight approx. 70gram.

7) TROUBLESHOOTING

The following table gives guidance on resolving some of the problems that you may encounter when becoming familiar with the *GEM*. Before using this table, please ensure that:-

- You have followed all the above instructions that are relevant (i.e. for DCC or non-DCC operation).
- The unit is wired exactly as shown in these instructions, as appropriate for your application.
- All electrical connections are sound. Ensure that wires are fully seated in the IDC connector(s) and that you have used the correct size wire – i.e. 7/0.2mm stranded!
- All wiring is undamaged.

PROBLEM	PROBABLE CAUSE(ES)	SOLUTION(S)
No response to DCC commands.	Incorrect address set.	Check and correct setting of CVs.
	Invalid accessory command being sent.	Consult your DCC system manual for the correct operation of accessories.
	Command being overridden by “C” input.	Remove any connections from “C” terminal and re-test. If the signal now works, ensure that you only have a <i>momentary</i> connection between “C” and “G”.
No response to “C” input.	Manual override disabled.	Check and correct setting of CV2.
No response to DC supply.	Non-DCC mode disabled.	Check and correct setting of CV2.
	Wrong type of power supply.	Ensure that you are using a steady, DC supply of between 11 to 18 volts.
	Power supply polarity not being reversed.	Check that you are using the correct type of switch (see figs.4&6) and that it is wired correctly.
Point blades “stop short” of stock rail.	Movement of drive pin restricted.	Check slot in baseboard under the point tiebar. Ensure that the <i>GEM</i> ’s drive pin is free to move over the full travel of the point blades.
	<i>GEM</i> is misaligned.	Check that..... The drive pin of the <i>GEM</i> is not touching the end of the slot in the PCB. If so, the <i>GEM</i> needs moving sideways slightly. The slot in the <i>GEM</i> ’s PCB (within which the drive pin runs) is lined up with the point tiebar. If not, the <i>GEM</i> needs rotating (on a “straight” point, the sides of the <i>GEM</i> ’s PCB should be parallel to the straight stock rail on the point).
Power supply, or DCC supply, overload or short-circuit occurring when using RAS1202 accessory switch to power “live frog”	Slow, or “sticky” point movement.	Check that the point mechanism is not restricted or excessively worn. Electrically isolate the point frog from the blades if the problem persists.
“State” indication LEDs will not illuminate.	LED(s) not connected correctly.	Ensure that one LED is connected between “A” and “G” and the other LED is connected between “B” and “G”.
	LED polarity incorrect.	Check that the LED <i>anode</i> is connected to “A” or “B” and that its <i>cathode</i> is connected to “G”.

CONSULT *GFB Designs* IF THE ABOVE SUGGESTIONS DO NOT HELP.

8) IMPORTANT INFORMATION

DISPOSAL OF WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT

European law requires that household waste from electrical and electronic equipment is collected separately from normal domestic waste and then properly recycled.

The *GEM* is marked with the crossed out wheeled bin symbol (shown opposite), in accordance with the European directive 2002/96/EC, which means that you must return any damaged or “end-of-life” units to your local authorised collection centre. *GFB Designs* will provide advice and assistance regarding the correct disposal procedures.



WARRANTY

All *GFB Designs* products are guaranteed against defects in materials and workmanship for a period of 24 months from the date of purchase. Should a defect arise within this period, the product will be repaired or replaced free of charge PROVIDED:-

- The product has been used and maintained in accordance with the manufacturer's instructions and (where applicable) any electrical ratings.
- No accidental physical damage has occurred whilst the product is in the customer's possession.
- The fault has not been caused by any other form of misuse or neglect on the part of the customer.

This guarantee is in addition to, and does not diminish, your statutory rights – for further information please contact your local Trading Standards Authority.

DECLARATION OF CONFORMITY

The undersigned declares that the *GEM* Digital Point Actuator - manufactured by *GFB Designs* (contact details below) - is, where applicable, in accordance with the European directives 93/68/CEE (CE marking) and 2004/108/EC (electromagnetic compatibility). Relevant parts of the following standards have been used to demonstrate electromagnetic compatibility:-

BS EN 61000-6-1:2007
BS EN 61000-6-3:2007



A handwritten signature in black ink, appearing to read 'Fraser Black'.

Fraser Black, Proprietor

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