DUAL CHANNEL SWITCH

INPUT AND OUTPUT USING ISM BAND

FITTING AND OPERATING INSTRUCTIONS

NoWyr

Dual Channel RF Switch

The NoWyr Radio Control switch can be used in many applications where a power is available to a system that requires remote operation and it is impractical, inconvenient or prohibitively expensive to allow direct connection by hard wiring. The signals are bi-directional therefore it is possible to use the system where it is essential to have positive confirmation that the switching has actually occurred. The unit can be either powered directly from the Mains (230V AC) or from a low voltage source (9-24V AC/DC) depending on customer specified unit.

Examples.

1. Machines where cabling could obstruct operation.
2. Control within building where cabling can cause damage to decorations, is difficult or labour intensive.
3. Between buildings where wiring may have to cross third party property.
4. Highway equipment there interconnection would involve expensive excavation or cabling vunerable to damage.
5. Locations where cable installation may cause undue inconvenience.
6. Security equipment where cable could be susceptible to tampering.
7. Remote sensing equipment.
8. Portable equipment comprised of multiple components, where interconnecting cable can be unsightly and cause health and safety issues. (e.g. temporary traffic signals) .

The NoWyr dual channel RF switch allows remote control switching at distances of over 1Km (line of site),with the facility for confirmation of switching, and limitless range if additional units are used as repeaters.
The unit is designed for Industrial applications, therefore employs a high quality radio telemetry techniques in order that communication will be tolerant to ŧreal world 'environmental conditions.
Each unit has 2 communication channels that can be individually configured as either a transmitter or receiver. This facility makes it possible to control 2 devices, or alternatively control a single device, with the ability to send provide positive feedback to confirm switching has taken place.
Each unit has a unique address so that only þaired 'units will communicate without the possibility of false triggering from other units operating in range.

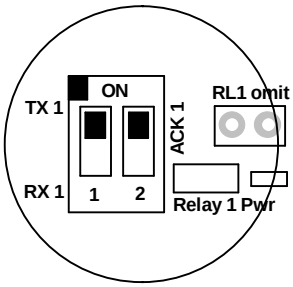
The standard unit has preset default settings, the user has the option to set-up the individual channels as Transmitter or Receivers, as described later in the switch setting information.

Alternatively the user can simply outline the application and specification and order a factory preconfigured system, NoWyr can supply at complete solution including wiring diagrams. This allows the user to specify complicated remote radio switching systems with the possibility of multiple transmitter and, or receiver units. The possibility of incorporating repeater units to extend the range is also an option.

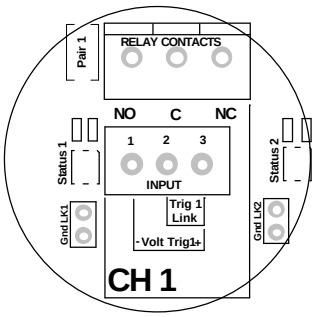
To allow even further flexibility NoWyr can supply software and a programming adaptor to allow the user to program specific functions that are required for specific applications. This is an extremely powerful facility as often applications are so specific that off the shelf solutions are not available. Programmability options allow cost effective solutions using the standard hardware, and possibly more importantly the time scale to achieve the specification can be extremely short. The configuration setting can be keep on file and used for additional systems or saved for programming replacement units.

CONFIGURATIONTION WITH STANDARD DEFAULT SETTINGS

Transmit Signal

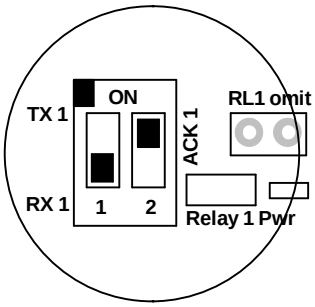


In order to set the unit to send a signal, the relevant channel must first be set up as a transmitter. This is achieved by setting switch 1 to TX. If the channel is sending information to one receiver then the unit can be set to acknowledge (switch 2 ON) so that it is possible to have confirmation that the signal has received. It is not possible to have confirmation if the transmit signal is broadcasting 'a switch command to several receivers.

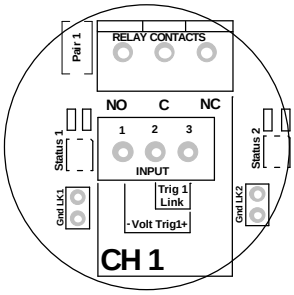


An ON 'command can to sent by either connecting terminals 2 and 3 on the input block from a clean contact or by applying a voltage between terminals 1 and 3. The voltage can be AC or DC, 5Vmin to 24V max. If the voltage is DC then the negative must be connected to terminal 1.
When an ON 'command is being sent the status LED will be green, when on OFF 'command is being sent the status LED will be red.
In addition to the status LED the associated relay will energise when an ON 'command is being sent.
If an acknowledgement is received the status LED will remain constant blinking briefly every 10 seconds when a confirmation signal is transmitted.
If no acknowledgement is received the status LED will flash indicating the transmit status.

Receive Signal

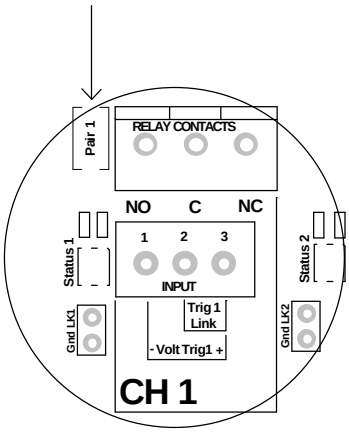


In order to set the unit to send a receiver the relevant channel it must first be set up as a receiver, this is achieved by setting switch 1 to RX. If the channel is receiving information to one transmitter then the unit can be set to acknowledge (switch 2 ON) so that it is possible to send confirmation that the signal has received. It is not possible to have confirmation if the receive channel is one of many that is being switched by one specific transmitter.



When an ON 'command is received the associated relay will energise and the adjacent red LED will illuminate to confirm operation. The relay will only be off when an OFF 'command is received or unit is first power up and an ON 'command has not been received.
The wiring is connected to the free screw terminal plug for ease of connection, with the relay contact designation clearly shown. The relay has an independent voltage free changeover contact rated at 5 Amps at 240V
The status LED will pulse every 10 seconds if the transmitter has received the acknowledge and every 5 seconds if the acknowledge has not been received, green will indicate an ON signal and red will indicate an OFF signal.

Pairing Transmit to Receive Channels



Each unit has a unique identity (key) so that a specific transmit channel can be paired to a receive channel. This will ensure that switching can be controlled without spurious switching occurring, caused by either general RF interference or by switching signals received by other systems operating in close proximity.

Before as system is configured for pairing, it is best to ensure that all channels are blank. This is best achieved by putting all channels into receive mode. If the channel is blank then the status LED will be yellow, if not then the channel must be cleared by holding down the associated pair button for about 10 seconds, after this period all codes will be erased and confirmation will be indicated by the LED going yellow.

Then next stage is to set up the transmit channel as described using the dip switch setting as described. The receive channel to which it is to be paired must be set up with acknowledge turned on.

Make sure that the input on the transmit channel is turned off, press the pair button, the status LED will flash red to indicate a pairing signal is being sent, this will time out after 60 seconds if a pairing is not achieved within this period.

Press the pair button on the receive channel that is required to be associated with the transmit channel. After a couple of seconds the red LED on the transmit channel will stop flashing become constant indicate the transmit has been paired, in the mean time the LED will flash green briefly followed by a constant red showing the receive channel has now been paired. The status of the LED on the receive channel corresponds to the signal being sent from the corresponding transmit channel.

The units can be set up in several configurations some examples of which can be shown below:-

1. **Two switching channels, i.e. one unit can be set up with both channels acting as a transmitters with acknowledgement, paired with a corresponding receiver**.

WIRING DIAGRAM

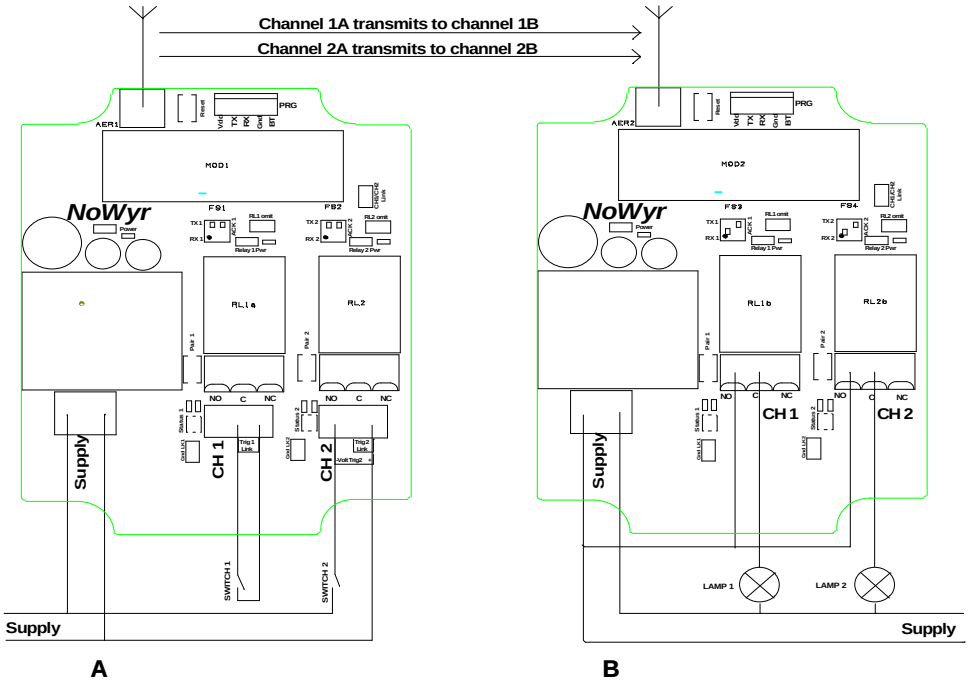


Fig1

The example in Fig 1 shows how a pair of units can be used to switch 2 independent channels. Unit 'A' transmits switched information to Unit 'B'.

Channel 1A transmits a on/off signal to Channel 1B. In this particular example the 'ON' command is sent simply by voltage free contact linking the terminals 2 and 3, and the OFF command by disconnecting the connection between terminals 2 and 3.

Channel 2A in the left hand unit is switched by a voltage applied between pins 1 and 3 (see wiring diagram), if DC is present apply negative to terminal 1 and positive to terminal 3, the application of a voltage causes an 'ON' signal to be sent. The voltage must NOT exceed 24V. Removal of the voltage causes the unit to send an 'OFF' signal.

In every other respect the operation of channel 2 is identical to channel 1.

2. **Bi directional switching, i.e. each unit can send on 1 channel and receive on the other**.

WIRING DIAGRAM

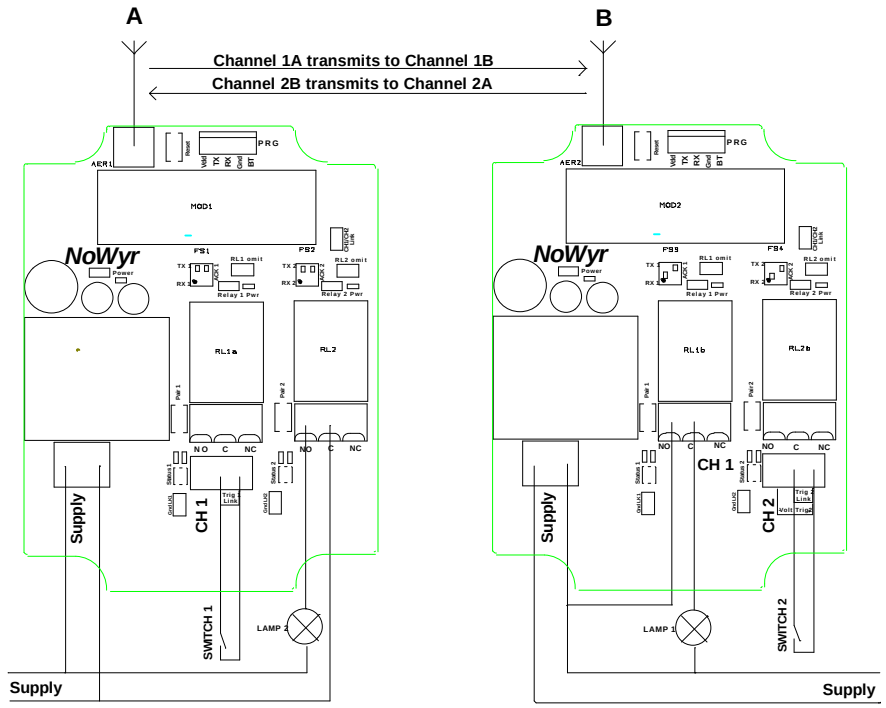


Fig2

This example in fig 2 shows how information can be sent in both directions. If Switch 2 was replaced by the contacts of a relay, with the relay being energised by connecting the coil in parallel with Lamp 1, then in this configuration, positive feedback could be confirmed by Lamp 2 being illuminated when an ON 'command has been received by channel 1B . It would not be possible for Lamp 2 to light if there a failure of any of the communication channels.

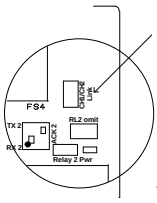


fig 3

The above return signal could more easily be achieved by applying a jumper link, this would connect the output of channel 1B in to the input of channel 2B. Please note that this will only confirm the communication link but will not confirm actual switching.

3. Long range switching using units as repeaters, unit A can operate unit C by using unit B as a repeater.

WIRING DIAGRAM

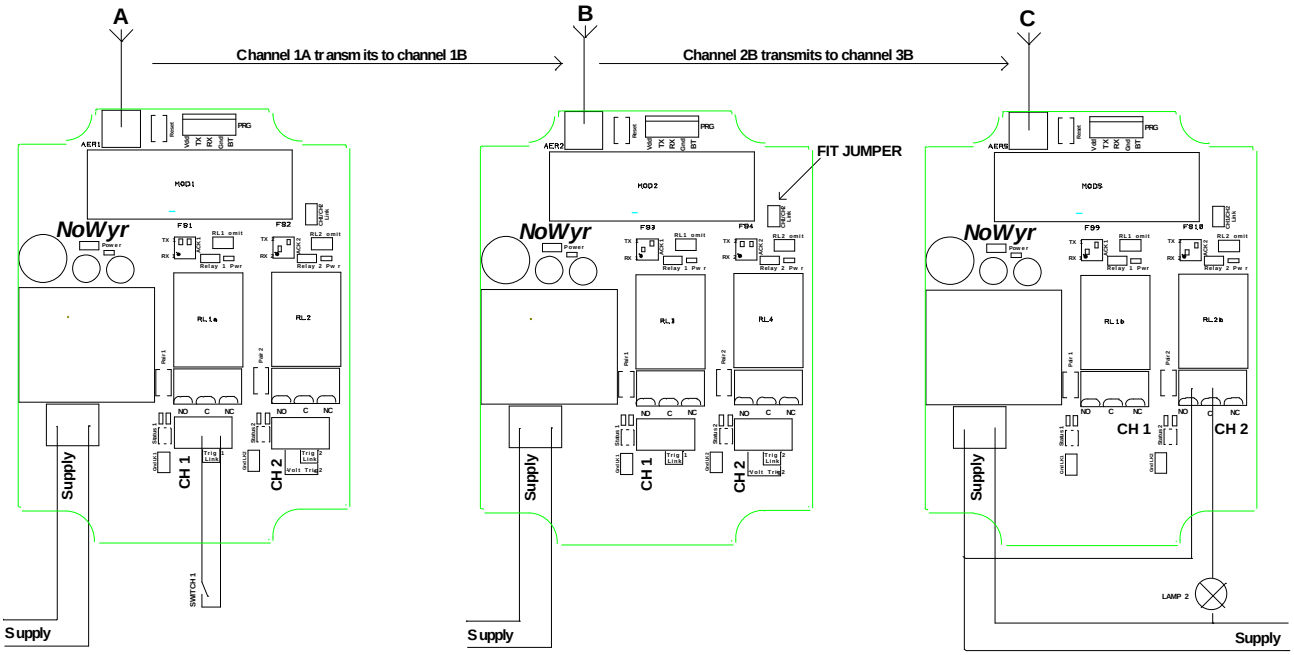
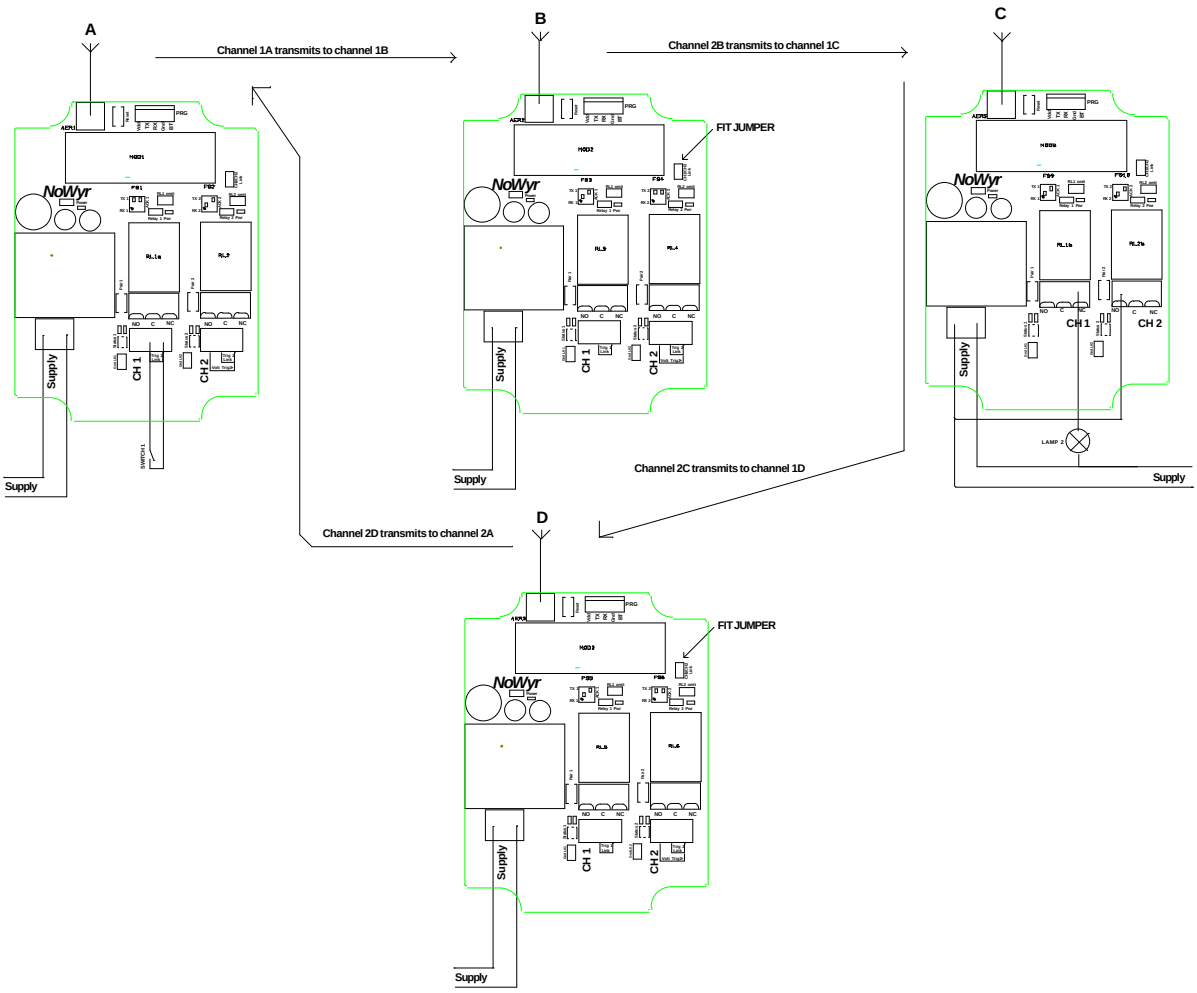


Fig 4

The above configuration in fig4 shows how the unit can be 'daisy chained' using intermediate units as repeaters.
In this configuration however it would not be possible to obtain positive feed back as there are no free channels on the repeaters for a return path. Unused channels can always be paired to other units.

4. Long range switching using units as repeaters, unit A can operate unit C by using unit B as a repeater. The addition of unit D can allow positive feedback.

WIRING DIAGRAM



The above configuration in fig5 shows how the unit can be 'daisy chained' using intermediate units as repeaters.
In order to obtain confirmation an additional unit D can be included to provide a return path from the final receive channel.

5. **Unit A can be paired to receivers B and C in different locations. Each receiver can be switched independently with acknowledge.**

WIRING DIAGRAM

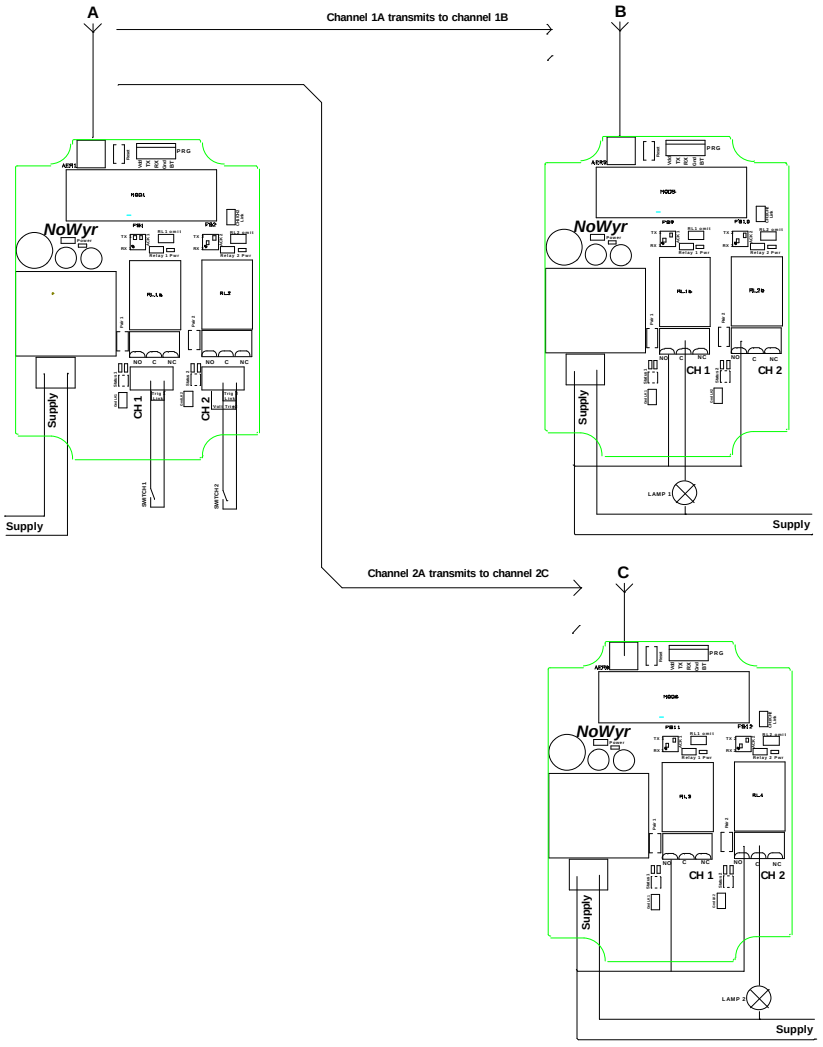


fig 6

The above example demonstrates how it is possible transmit a switching command from a single location to units receivers placed apart. As independent channels are used acknowledgement can still be achieved. Please note in this example Channel 2 on unit B and Channel 1 on unit C is still available for pairing if required.

6. Unit A can 'Broadcast' 2 commands to B and C using a both channels .

WIRING DIAGRAM

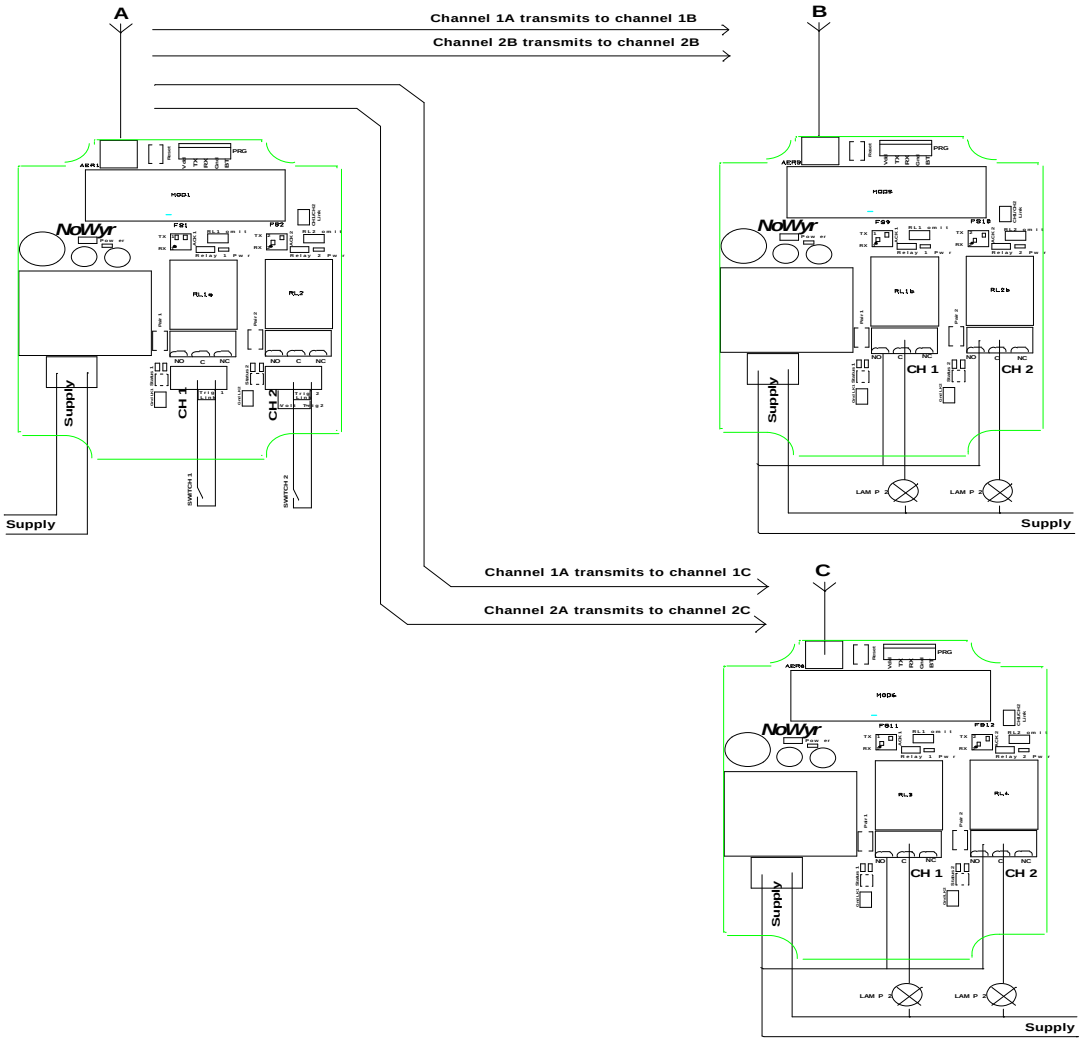


fig7

The above example in fig 7 demonstrates how it is possible transmit a 2 switching commands from a single location to units receivers placed apart. As transmit channels are used to broadcast 'commands to more than 1 receiver it is not possible to achieve an valid acknowledgement.
Acknowledgement cannot be enabled, as all units that receive the command would attempt to acknowledge simultaneously therefore it would not be possible to can confirm the acknowledge is received from all units.
Additionally if an acknowledge was received from 1 unit, the transmitter would not attempt retries for units that may have missed a switching command.

7. Unit C and receive switching commands from multiple transmitters A and B. (Limited to 6)

WIRING DIAGRAM

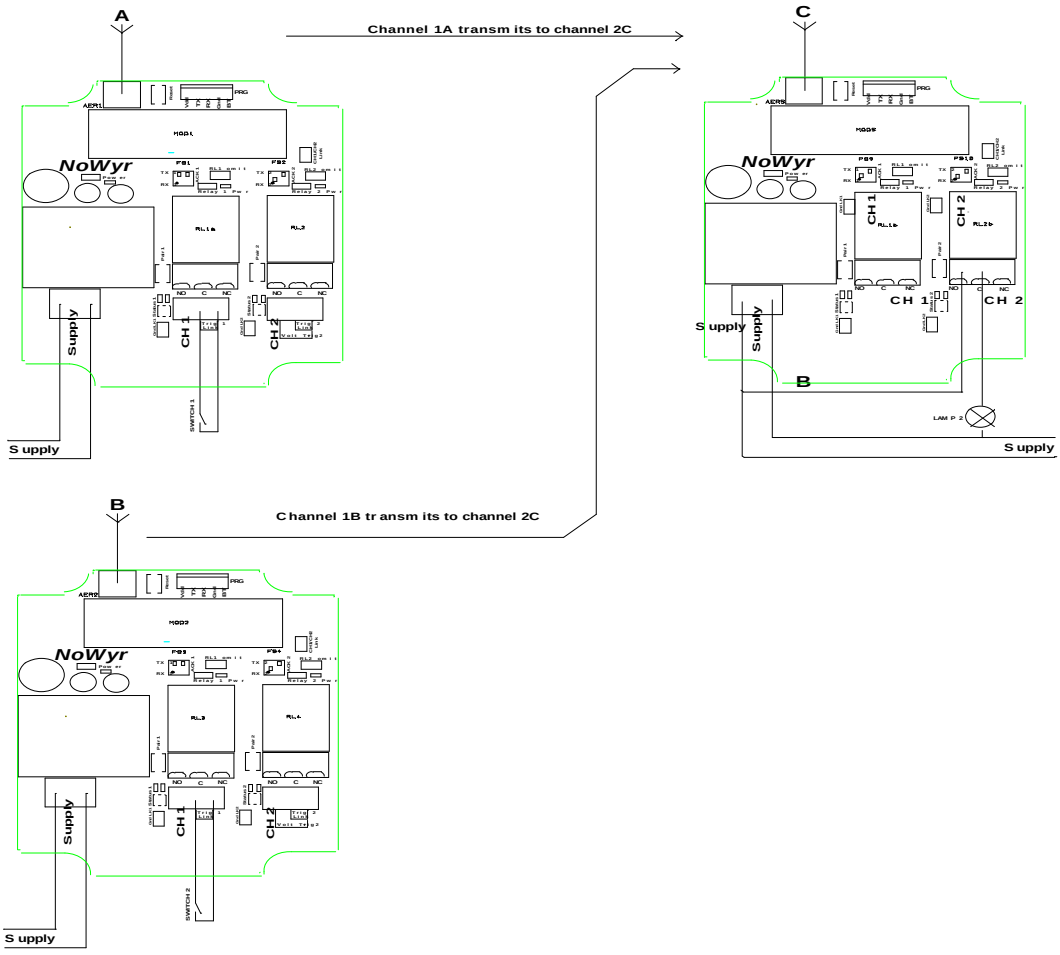


fig 8

The above example in fig 8 demonstrates how it is possible transmit a switching command from several transmitters
placed apart. As transmit unit 'A 'can send switch commands independently to receivers B 'and C ' it is possible to achieve an valid acknowledgement, as the receiver can acknowledge the transmit from unit 'A ' independently.

It must be noted that it is likely if units that have the standard default settings, that it is possible that different transmitters are sending conflicting switch commands, in this case the receiver will respond to the last command that is received.
If used in this configuration it may be necessary to specify the application before purchase or use the configuration kit with software, details of with are detailed in further on.

INSTALLATION

The NoWyr dual channel RF Switch has been designed so radio controlled switching can easily and reliably achieved using the products straight off the shelf.

The units are available in 2 versions clearly marked, Mains and the low voltage (12-24V AC/DC), and is
supplied in a IP65 rated enclosure with an external aerial attached, mounting holes are provided. It is important the enclosure is mounted with the cable entry gland pointing downwards so that water cannot run along the cables into the circuitry and that the appropriate unit is selected for the supply voltage. All relay contacts are ‘clean, voltage free ’ with a maximum current of 10 Amps at 240V AC or 28V DC.
All wiring must made with non stranded cables and meet all current IEEE standards.

The units are usually supplied in pairs and pre-configured and coded so that Channel 1 on each unit sends a switching command to Channel 2 on the other unit , the acknowledge is activated.
It is a simple procedure to configure weather a channel is set up as a transmitter or receiver as described earlier, this allows the system to be extremely versatile and allow for numerous switching applications.

Some applications can innovatively become a little more complex, for this reason NoWyr also offer a ‘pre-configure ’service so that the customer can simply detail the exact requirements, so that a system can be despatched with all parameters set appropriately, if required a specific application wiring diagram can be supplied. Usually the units can be despatched the same day.
If required, NoWyr can supply free software that will allow the customer access to change the more detailed parameters, to allow this, a simple interface unit that is available separately that will facilitate direct programming from a PC.

HOW IT WORKS

For simple operation using the standard default settings it is not necessary to continue with this section. However if the standard configuration, will not allow a complete application solution or just for general interest, a more detailed understanding will allow the user to appreciate the addition functionality that is not normally available on simple remote control switches, and how the units can be used in so many diverse applications.

As the system operates in ISM licence free radio bands, it is likely that other equipment will be operating with close proximity, therefore is both a legal and practical requirement that the system will not adversely affect or be affected by other radio systems.

Unique Key

In order that a receive channel is not affected by random radio signals or other channels that are not allocated, each transmit channel is identified by a unique code derived from the RF Module serial number. As a serial number is never repeated spurious operation from other NoWyr channels will not be possible. In addition the key is sufficiently complex and verifiable that is statistically almost impossible for false operation from random radio signals.

Polling and Acknowledgement

If a channel is set as a transmitter it needs to send the switch status command via a radio signal, every time the switch status changes, an updated command will be sent. If the status if the channel was continuously transmitted the unit could potentially block the operation of all other channels and other radio equipment operating locally. Alternatively if the signal was transmitted only when the switch status changes, radio interference at the time of transmission could result in the receive channel failing to operate. To solve this problem, the system resends the command information periodically so that the receive channel will operate correctly.
The default settings on the system are 5 seconds for 'short polls' and 10 seconds for 'long polls'

Transmit with Acknowledgement On

If a channel is set to transmit with acknowledge, every time the status of the transmit command changes, immediately this is change is transmitted. The receive channel to which it is paired should receive this command and send return an acknowledgement to the transmit channel. If the transmit channel fails to receive an acknowledgment, it will keep resending the status command for the maximum number of retries allowed (the default setting is 3 retries).
If the transmit channel fails to receive any acknowledgement that it will try again after a preset period, this is referred to as the 'short poll' period. If as normally the case, the transmit channel receives an acknowledgement it will not be necessary for the transmit channel to retry, as the transmit channel knows 'its command has been received the next status command will be sent again after the time set by the 'long poll' parameters. As the status command requires less to 20 milliseconds, typically the transmitting less 0.2% of the time.
Using the acknowledge makes sure that unnecessary commands are not sent, which in turn has the advantage of minimising the radio traffic and reducing the likelihood of problems being caused by different transmit channels sending status commands simultaneously creating receive errors.
Increasing the number of retries or reducing the 'short poll' and 'long poll' periods will have the effect of increasing the percentage period of radio transmission. The longer the radio transmission from any particular channel the more likely it is that it will block the operation of other channels.
To comply with relevant current legislation it is important not to exceed the transmit duty cycle allowed for the particular frequency and power output, this information is available for the UK on the Radio Agency Web Site.

Transmit with Acknowledgement Off

If a transmit channel is associated with more than 2 or more receive channels the acknowledge must not be used so it is important that the acknowledge is turned off on all the associated transmit and receive channels. Acknowledge cannot be used because once a status command is received by more than one receive channel then all the receive channels will simultaneously acknowledge, this will have the effect of either corrupting the radio data or possibly stopping the transmitting retries even if some channels have not received a valid status command.
Every time the transmit channel sends a status command will be send the number of times as set by the retry parameter, (the default setting is 3 retries). This is the case due to the fact that the transmit channel cannot confirm that the receiver channels have actually received the command, so by repeating the transmission helps to ensure that the unit will operate reliably. The poll rate will always be set by the 'Short Poll' time setting as the 'Long Poll' setting only applies once an acknowledge has been received.
It is important to be aware that when the acknowledge is not used the percentage of radio transmission time is much longer as the transmit channel always retries the maximum number of times and this will happen more frequently as this is governed by the 'Short Poll' setting.
To illustrate the point, if the retries were set to 50 and the 'Short Poll' was set to 1 second, then the transmit channel would be permanently sending radio data due the fact that 50 retries would occupy all the time between polls, as a result this would block all the other channels and possibly prevent the operation of other equipment in the area.

Off Timer

If this timer is not set (0), the receive channel output will remain in the state of the last switch command, therefore if communication was lost it would not be necessarily obvious, this would be undesirable, especially if the system is being used for alarm or monitoring systems.

The default 'Off Timer' setting is 60s seconds, so that every time an 'ON' command is received the timer will reset so the output will remain 'ON' for a further 60 seconds in the absence of a signal, as the 'Long poll' is set to 10 seconds the receive channel will remain 'ON' without interruption provided the communication link is operating correctly.

The main advantage of using the 'Off Timer' is that if a fault occurs, this can be made apparent. Depending on the application the time required indication of loss of communication the can be set appropriately. The quicker the response, the more radio traffic will be used, this is because the frequency of the polling needs to be increased so that the 'poll' time is more frequent than the duration of the 'Off Timer'. It would be good practice to set the longest period acceptable for the application so the radio traffic is kept to a minimum.

A typical example of how this can be used would be for an over temperature sensor. In this application the fault could be sent remotely, however if communication failed it would be essential that the fault would be reported quickly otherwise it would not be apparent that the protection system would be ineffective. The long poll could be set to 2 seconds and the 'Off Timer' to 6 seconds, with this configuration if a fault occurs then there would be a maximum of 6 seconds before the fault would be apparent, however as the status would be sent every 2 seconds, even if the odd command failed the get through, the system would not send false fault reports.

Another example of how this can be used would a level sensor on a storage tank. In this application the low level could be sent remotely, however if communication failed it would be essential that the fault would be reported. However it may be acceptable if the fault is not reported immediately. In this case the 'Long Poll' and 'Short Poll' could be set to 200 seconds, and the 'Off Timer' set to 2000 seconds, the communication fault would still be reported but the radio traffic would be kept to a minimum, reducing the chance of interference between channels.

Toggle Input

This function in provided so that if it is required the input link can be replaced by a single pole 'push' switch. The switch status will the toggle between 'ON' and 'OFF' with every press of the switch so that alternate action switching can be achieved. Setting the toggle setting to '1' enables this function.

Invert Input

The input default sends an 'ON' command when input terminals 2&3 are linked or a 5-24V supply is applied between input terminals 1&3. If the reverse is required, with an 'ON' command required to be sent with a link being broken or the removal of a voltage, then setting to Invert Input to '0' will achieve this.

Invert Output

By default the relay is energised when an 'ON' command is received and de-energised when an 'OFF' command is received this can be inverted by setting the Invert Output to '1'. Although the relay provides a changeover contact, it may be desirable to have the relay de-energised if the application has condition when this would be the case majority of the operating period, this will have the effect of reducing the overall power consumption of the unit.

Save State

This function is by default off, therefore if power is lost, when the power is resumed the output will power up in the 'OFF' condition and remain in this state until an 'ON' command is received. It may be useful if the output status is resumed without the need to receive an 'ON' command. To enable this function the 'Save State' must be set to '1'.
However for reasons of safety in some circumstances it may be better for the unit always to power up in the 'OFF' state.

ON's Only

In some applications it may be required for 1 receive channel to be controlled by several transmitters. To illustrate why this may be require this function we can look at a typical example.

A security light may be required to the turned 'ON' by the triggering of any 1 of several remote sensors, when a sensor is triggered an 'ON' command will be sent and the security light would be turned 'ON'. However as the light would be controlled by several sensors, the other sensors would be sending 'OFF' commands, therefore the security light would be receiving both 'OFF' and 'ON' commands which would create sporadic switching of the light. If all the transmit channels only sent 'ON' commands, then the light would be activated by any of the sensors, the 'Off Timer' must be set so that the light would turn 'OFF' after a pre-determined period. If additional 'ON' commands were received, the 'ON' period would be extended with the light turning 'OFF' the number of seconds set by the 'Off Timer' since the last 'ON' command was received.

Receive Toggle

In some applications it may be required to control a device from two locations. To illustrate why this may be require this function we can look at a typical example.

A conveyer belt may be required to be started or stopped from 2 locations. Both transmit units could be set to send 'ON' commands, however in this instance the receive channel will toggle when an 'ON' command is received so that the receive channel can be turned 'ON' of 'OFF' by alternate, action from any transm

The receive unit could if required use the second channel to broadcast the status back to all the sender units.

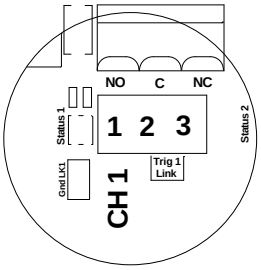
Learn 'Timeout'

When pairing a transmit channel to a receive channel, once transmit channel has been instructed to send out a 'pairing' signal the user has 60(Set by default) seconds to enable the 'pairing' on the receive channel to which it is to be associated, normally this will be sufficient.
In some circumstances when the transmit channel and the receive channel are a significant distance apart, it may not be possible to enable the 'pairing' of the receive within this time frame, in this case the 'pairing' period can be extended using the software provided.

Hardware Options

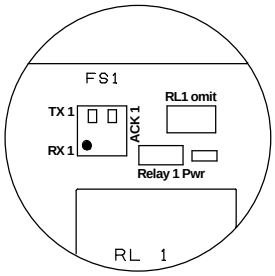
Input Isolation

Both input channels are optically coupled to offer a degree of electrical isolation. In order that a link can be used to allow a switch input, terminal 1 of the input block is connected to ground via a resistor. In some applications for electrical safety or when the unit needs to be 'low side' switched from the same source that is used to supply the unit itself, cutting the 'Gnd LK' will result in total electrical isolation between the input and all other parts of the circuit.



Relay Disconnect

Each channel can be set to Transmit via an input optocoupler or Receive with the output being provided by a relay.
The input and output is connected to the same I/O line, therefore if there is an electrical input created by a link or application of a voltage, then even if the unit is set up to be a transmit channel the relay will still energise. In some case this can be useful e.g. if the systems was designed so that a single input the transmit unit was used to switch channels on 1 or more receiver units, the relay on the transmit unit could be used to switch local device.
In other applications where a channel was used as a transmit device it maybe desirable to disconnect the relay to prevent audible 'clicking' or reduce the power consumption when a switch input is present, this can be achieved by cutting the 'RL Omit' link as shown.



Application Software

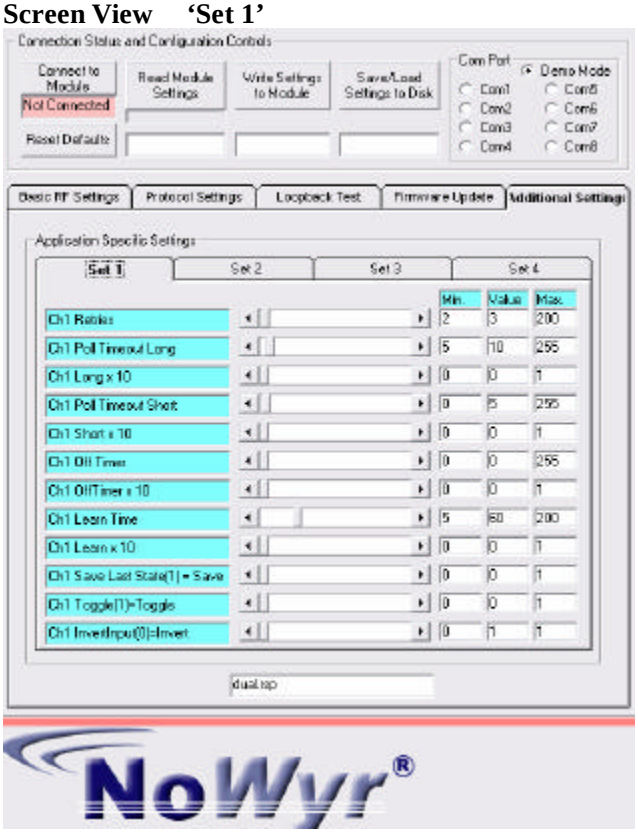
The How it Works 'section gives a brief insight as to why some of the configuration functions are required in order that relatively simple radio controlled switching may be achieved.

NoWyr has implemented this flexibility so that a simple pre-configured system can be provided using standard hardware, this provides for a reliable, fast solution whilst minimising the total cost.

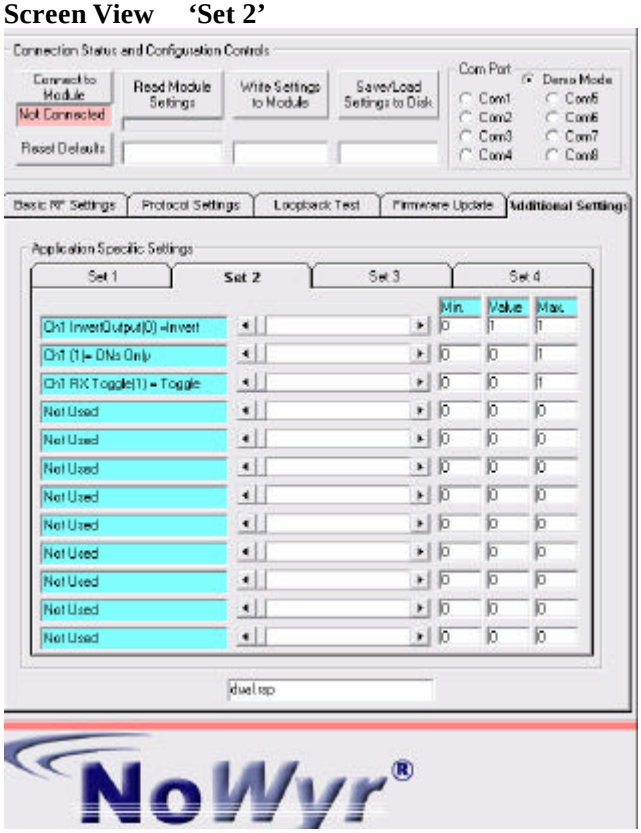
Whilst this system can be a solution to most remote radio switching requirements, NoWyr will where viable offer the possibility of further bespoke customisation.

The Screen View 'below shows how the simple it is, should the user require to configure the system using the available software.

Screen View 'Set 1'



Screen View 'Set 2'



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NOTES

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