Updating your car entertainment system? You will probably need this

STEERING WHEEL AUDIO BUTTON TO INFRARED ADAPTOR

by John Clarke

If you upgrade the radio or 'infotainment' head unit in a car with push-button steering wheel controls, those controls may stop working. That's because many aftermarket head units do not support steering wheel controls, the implementation of which often varies between manufacturers and even between models. This adaptor lets you use most of those very handy controls with a wide range of aftermarket head units.

Once upon a time (would you believe way back in 1930?) car manufacturers started fitting car radios. Nothing fancy, mind you – just a basic AM receiver.

Over the years, buyers demanded more: push-button tuning, FM tuners, 8-track players, cassette players, CD/DVD players and so on. In more recent times, we've seen that expand to include auxiliary inputs, USB and SD-card readers, Bluetooth and even inbuilt navigation systems.

To control all this technology, "head units" were created – essentially a dedicated computer in its own right – with not just the source but such things as volume, radio station, track selection and more selected via push-buttons and, becoming more popular, an infrared remote control.

And then someone got the bright idea to incorporate those push-buttons into the steering wheel – and the Steering Wheel Controller (SWC) was born, offering remote control without taking your eyes off the road for very long (if at all).

Some head units incorporate a remote control input wire at the rear of the unit and are operated via a voltage or digital signal.

Fortunately, with our adaptor it doesn't matter which system the head unit supports (if any) – just so long as it also offers infrared remote control. Almost all modern head units do.

These handheld remotes are small and fiddly to use, and we don't recommend that they're used by the driver because they are too distracting. That's if the driver can find it in the first place: they have the annoying habit of falling down between the seats!

Our SWC Adaptor can operate the head unit using infrared control and it is, in turn, controlled by the steering wheel buttons. So you don't even need to open up your head unit to use it. You can feed the IR control signals in through the faceplate.

Note that some SWCs are digital; they may be connected via a Controller Area Network (CAN) bus or a proprietary system. These are not suitable for use with this adaptor. It works with controls where each switch connects a different resistance between a particular wire and chassis (0V) when pressed.

Before embarking on this project, it would be wise to check that your steering wheel controls are suitable for use with the SWC Adaptor. See the panel entitled "Are your steering wheel controls suitable?"

Features

- Compact unit, can be hidden away under or behind the dash or even inside the head unit
- Works with up to 10 resistance-based steering wheel buttons
- Controls head unit via infrared signals (requires remote control capability)
- Works with most head units (using NEC, Sony or RC5 infrared codes)
- Infrared receiver included for programming the function of each button
- Easy set-up by learning remote control codes for each steering wheel button
- Optional unmodulated infrared output for direct wire connection
- Two non-repeat buttons for special functions (see text)

We housed the adaptor in one of Jaycar's flanged UB5 Jiffy boxes (Cat HB6016) because it makes mounting that much easier.

The only other requirement is that head unit uses one of these three infrared remote control protocols: NEC, Sony or Philips RC5. Virtually all head units with remote control use one of those three.

By far the most common is the NEC format. This is used by most head units manufactured in Asia including Pioneer, Akai, Hitachi, Kenwood, Teac, and Yamaha plus Germany-based Blaupunkt.

The Sony protocol is the next most common. The RC5 format is used by Philips and some other European brands, although we have seen some Philips products which use the Sony format

Presentation

The SWC Adaptor comprises a small PCB which can fit into a small Jiffy box. It's connected to an ignition-switched 12V supply and the steering wheel control wire. It provides two outputs: one to drive an infrared LED to operate the head unit, and a second for an optional direct wire connection which can control the head unit directly, without the need for an infrared transmitter. More on that later.

In use, the SWC Adaptor can be programmed to map up to ten steering wheel buttons to separate infrared codes to send to the head unit. Once programmed, it can be hidden away (eg, under or behind the dash) and the steering wheel buttons can be used to control the head unit while the vehicle ignition is on.

Circuit description

Fig.1 shows the circuit of the SWC Adaptor. It is based around microcontroller IC1, a PIC12F617-I/P. This

Are your steering wheel controls suitable?

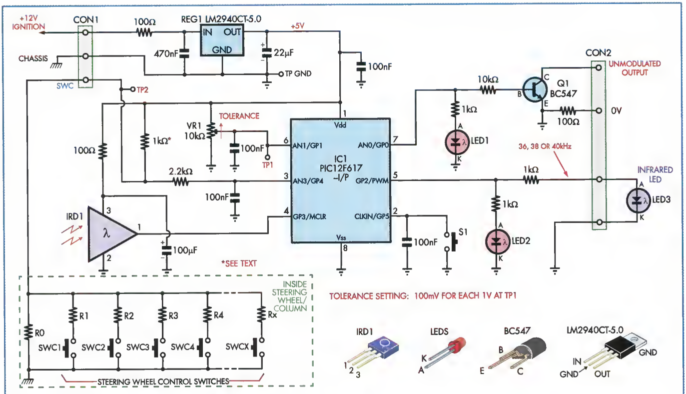
Before deciding to build the SWC Adaptor, you will need to check that the steering wheel control switches are the type that switch in a resistance rather than digital types that produce a series of digital (on and off) signals when the switch is pressed. We also assume that the head unit you intend to use has infrared remote control and uses one of the standard protocols as mentioned in the article.

To check the SWC switches, your original equipment head unit will offer clues as to which wire this is. There should be a connection diagram on the head unit. Or you can find the wire using a vehicle wiring diagram.

With the ignition off and the SWC wire not connected to the head unit, connect your multimeter leads between that wire and vehicle chassis. Set the multimeter to read resistance. The resistance may read very high ohms when the SWC switches are all open or it may be a few thousand ohms. Pressing each SWC switch in turn should show a different resistance reading.

For example, our test vehicle showed a resistance of 3.5kΩ with all switches open. Then the switch readings were 160Ω, 79Ω, 280Ω, 450Ω, 778Ω and 1.46kΩ for each of the six switches. So these readings prove that the steering wheel controls are the analog type that switch in resistance and so is suitable for use with the SWC Adaptor.

If you do not get resistance changes, check that you are monitoring the correct wire and that the chassis connection is good. If the switches still do not show resistance, they might be producing a digital signal when the vehicle ignition is on. The steering wheel controls on your vehicle are therefore not suitable for use with the SWC Adaptor.



SC ©2019 **STEERING WHEEL CONTROL ADAPTOR**

Fig.1: IC1 monitors the steering wheel controls via analog input AN3, while also sensing tolerance adjustment trimpot (VR1) at analog input AN1. The state of switch S1 is monitored at digital input GP5 and the signal from infrared receiver IRD1is monitored at digital input GP3. To control the vehicle head unit, IC1 produces remote control code pulses at its pin 5 PWM output. These codes are transmitted in 36-40kHz bursts, to drive infrared LED3. An identical, non-modulated signal is also sent to the GP0 digital output (pin 7). This has the advantage that you can wire it in place of the infrared receiver, for a direct wired connection to the head unit.

monitors the steering wheel controls via analog input AN3, while also sensing tolerance adjustment trimpot (VR1) at analog input AN1, the state of switch S1 at digital input GP5 and the signal from infrared receiver IRD1 at digital input GP3.

To control the vehicle head unit, IC1 produces remote control code pulses at its pin 5 PWM output. These codes are transmitted in 36-40kHz bursts, to drive infrared LED3. An identical, non-modulated signal is also sent to the GP0 digital output (pin 7). This has the advantage that you can wire it in place of the infrared receiver, for a direct wired connection to the head unit.

The exact modulation frequency depends on the infrared protocol that the unit is set up for. It is 36kHz for the Philips RC5 protocol, 38kHz for the NEC protocol and 40kHz for the Sony protocol.

In more detail, the SWC input at CON1 has a 1kΩ pull-up resistor to the 5V supply. This forms a voltage divider across the 5V supply, in combination with the steering wheel switch resistances, giving a different voltage at analog input AN3 (pin 3) of IC1 for each switch that is pressed.

This voltage is applied to the AN3 input via a low pass filter comprising a 2.2kΩ resistor and 100nF capacitor. IC1 converts the 0-5V voltage to a digital value between 0 and 255.

So for example, a 2.5V signal would be converted to a value of 127 or 128, around half of the maximum value of 255.

As for the AN1 input, the 0-5V from trimpot VR1's wiper is converted to a digital value. The 0-5V range of VR1 is mapped in software to a 0-500mV range of tolerance.

So If VR1 is set midway at 2.5V, the tolerance setting is 250mV (1/10th of the wiper voltage, measured at TP1). So the SWC input voltage can differ from its stored value by up to ±250mV and still be recognised as that particular switch.

Tolerance is essential since the SWC voltage may vary with temperature due to resistance variation in the switch resistor, and switch contact resistance can also cause voltage variation.

Having detected a valid SWC button press, IC1 activates its pin 5 and 7 outputs to produce the appropriate remote control code to send to the vehicle head unit.

The modulated output at pin 5 has a 50% duty cycle. It can drive an infrared LED via a 1kΩ resistor and CON2. LED2 is also driven by the PWM output during transmissions, as a visible indication.

The unmodulated output from pin 7 drives the base of NPN transistor Q1 via a 10kΩ resistor and also LED1, via a 1kΩ resistor. The collector of Q1 is open so that it can connect directly to the IR receiver in the head unit. The emitter is isolated from ground via a 100Ω resistor to reduce current flow due to the possibly differing ground potentials in this unit and the head unit.

Fig.2 shows the output signals at pins 5 (yellow) and the collector of Q1 (cyan), demonstrating the 36-40kHz modulation applied to pin 5 but not Q1's collector. In this case, the NEC protocol is being used so the modula-

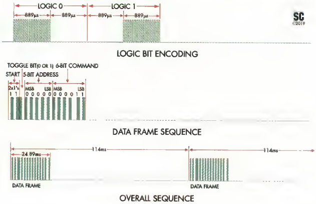
Infrared Coding

Most infrared controllers switch their LED on and off at a modulation frequency of 36-40kHz in bursts (pulses), with the length of and space between each (pauses) indicating which button was pressed. The series of bursts and pauses is in a specific format (or protocol) and there are several commonly used. This includes the Manchester-encoded RC5 protocol originated by Philips.

There is also the Pulse Width Protocol used by Sony and Pulse Distance Protocol, originating from NEC.

For more details, see application note AN3053 by Freescale Semiconductors (formerly Motorola): siliconchip.com.au/link/aapv

Philips RC5 (Manchester-encoded) (36kHz)



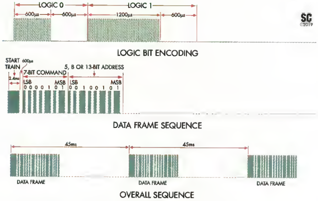
For this protocol, the 0s and 1s are transmitted using 889µs bursts and pauses at 36kHz. A '1' is an 889µs pause then an 889µs burst, while a '0' is an 889µs burst followed by an 889µs pause. The entire data frame has start bits comprising two 1s followed by a toggle bit that could be a 1 or 0. More about the toggle bit later.

The data comprises a 5-bit address followed by a 6-bit command. The most significant command bits come first.

When a button is held down, the entire sequence is repeated at 114ms intervals. Each repeat frame is identical to the first. However, if transmission stops, then the same button is pressed again, the toggle bit changes. This informs the receiver as to how long the button has been held down.

That's so it can, for example, know when to increase volume at a faster rate after the button has been held down for some time.

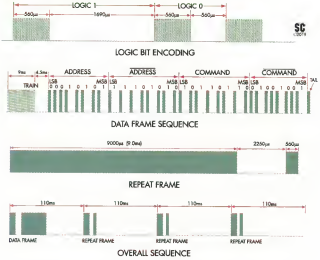
Sony Pulse Width Protocol (40kHz)



This is also known also as SIRC, which is presumably an acronym for Sony Infra Red Code. For this protocol, the 0s and 1s are transmitted with a differing overall length. The pause period is the same at 600µs, but a '1' is sent as a 1200µs burst at 40kHz, followed by a 600µs pause, while a '0' is sent as a 600µs burst at 40kHz followed by a 600µs pause.

The entire data frame starts with a 2.4ms burst followed by a 600µs pause. The 7-bit command is then sent with the least significant bits first. The address bits follow, again with least significant bits first. The address can be 5-bits, 8-bits or 13-bits long to make up a total of 12, 15 or 20 bits of data. Repeat frames are the entire above sequence sent at 45ms intervals.

NEC Pulse Distance Protocol (PDP) (38kHz)



For the NEC infrared remote control protocol, binary bits zero and one both start with a 560µs burst modulated at 38kHz. A logic 1 is followed by a 1690µs pause while a logic 0 has a shorter 560µs pause. The entire signal starts with a 9ms burst and a 4.5ms pause.

The data comprises the address bits and command bits. The address identifies the equipment type that the code works with, while the command identifies the button on the remote control which was pressed.

The second panel shows the structure of a single transmission. It starts with a 9ms burst and a 4.5ms pause. This is then followed by eight address bits and another eight bits which are the "one's complement" of those same eight address bits (ie the 0s become 1s and the 1s become 0s). An alternative version of this protocol uses the second series of eight bits for extra address bits.

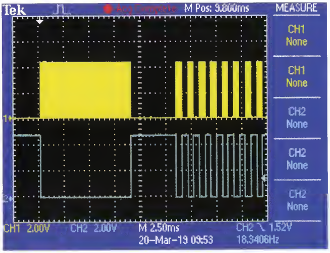
The address signal is followed by eight command bits, plus their 1's complement, indicating which function (eg volume, source etc) should be activated. Then finally comes a 560µs "tail" burst to end the transmission. Note that the address and command data is sent with the least significant bit first.

The complementary command bytes are for detecting errors. If the complement data value received is not the complement of the data received then one or the other has been incorrectly detected or decoded. A lack of complementary data could also suggest that the transmitter is not using the PDP protocol.

After a button is pressed, if it continues to be held down, it will produce repeat frames. These consist of a 9ms burst, a 2.25ms pause and a 560µs burst. These are repeated at 110ms intervals.

The repeat frame informs the receiver that it may repeat that particular function, depending on what it is. For example, volume up and volume down actions are repeated while the repeat frame signal is received but power off or mute would be processed once and not repeated with the repeat frame.

Fig.2 shows the output signals at pin 5 of IC1 (yellow) and the collector of Q1 (cyan), demonstrating the 36-40kHz modulation applied to pin 5 but not on Q1's collector. Note that the collector has a 10kΩ pullup resistor to 5V in order to be able to show the voltage swing from Q1. In this case, the NEC protocol is being used so the modulation is at 38kHz.



tion is at 38kHz.

The unit is set up using infrared receiver IRD1. This three-pin device incorporates an infrared photodiode, amplifier and automatic gain control plus a 38kHz bandpass filter to accept only remote control signals, within a few kHz of the carrier frequency.

The filter is not narrow enough to reject the 36-40kHz frequencies that could be produced by various different remote control units.

IRD1 removes the carrier, and the resulting digital signal is fed to the GP3 digital input of IC1 (pin 4), ready for code detection.

IRD1 runs from a 5V supply filtered by a 100Ω resistor and 100µF capacitor, to prevent supply noise causing false IR code detection.

Pushbutton switch S1 is bypassed with a 100nF capacitor to filter transients and for switch debouncing. The voltage at digital input GP5 is held at 5V via a weak pull-up current, internal to IC1.

When S1 is pressed, GP5 is pulled low to 0V and IC1 detects this. S1 is used during programming and to set a new tolerance adjustment.

The circuit is powered from the vehicle's 12V ignition-switched supply, fed in via CON1. This supply goes through an RC low-pass filter (100Ω/470nF) and then to automotive 5V linear regulator REG1, to power IC1 and the rest of the circuitry.

The LM2940CT-5.0 regulator will not be damaged with a reverse supply connection or transient input voltage up to 55V, for less than 1ms.

These situations can occur with some regularity in vehicle supplies, eg, with an accidentally reversed battery or when windscreen wiper motors switch off etc.

Construction

The SWC Adaptor is built on a PCB coded 05105191, measuring 77 x 47mm. It fits into a UB5 Jiffy box. The overlay diagram, Fig.3, shows how the components are fitted.

Start with the resistors. These are colour coded as shown in the parts list. It's a good idea to use a multimeter to check the value of each set of resistors before fitting them, as the colour codes can be confused.

We recommend using a socket for IC1. Take care with the orientation when installing the socket and IC1.

The capacitors can be fitted next. The electrolytic types must be installed with the polarity shown, with the longer positive lead towards the top of the PCB. The polyester capacitors (MKT) can be mounted with either orientation on the PCB.

REG1 can be then installed. It's mounted horizontally on the PCB. Bend the leads so they fit the PCB holes with the tab mounting holes lining up. Secure the regulator to the PCB with the screw and nut before soldering the leads.

The infrared receiver (IRD1) also mounts horizontally, with the lens facing up and with the leads bent through 90° to fit into the holes.

Trimpot VR1 is next. It has a value of 10kΩ and may be marked as either 10k or 103. Follow that with the LEDs (LED1 and LED2). The anode (longer lead) goes into the hole marked "A" on the PCB. The LEDs should be installed with the base of their lenses about 5mm above the PCB. Switch S1 can also be fitted now.

Next, solder transistor Q1 to the PCB, with its flat side facing as shown. You may need to bend its leads out (eg, using small pliers) to fit the pad pattern on the board.

Now install the two screw terminal blocks. CON1 is mounted with the wire entry holes towards the left-hand edge of the PCB while CON2 should be fitted with the wire entries toward the right-hand edge. You can make up a 4-way terminal by dovetailing two 2-way terminals.

If you are using a socket for IC1 as suggested, plug in the chip now, ensuring that its pin 1 dot is orientated as shown in Fig.3.

Housing it

The SWC Adaptor may fit inside the head unit if there is room, or you can mount it outside the head unit in a UB5 box. We used a flanged box that has an extended length lid with extra mounting holes. This makes it easier to

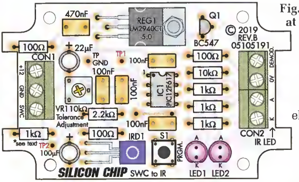
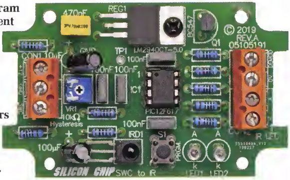


Fig.3: the overlay diagram at left shows component placement while the matching fully component installed PCB is shown at right. Make sure the two electrolytic capacitors and IC1 are correctly oriented with the shown polarity.



mount in the car, under the dashboard is the logical location.

Alternatively, a standard UB5 box can be used instead, or the unit can be wrapped in insulation and cable tied in position.

If fitting it into a box, drill holes at either end to fit the cable glands which allow the power supply and infrared LED wiring to pass through.

There are cut-outs in the PCB to accommodate the gland nuts which go inside the box. But note that these nuts must be oriented correctly, with two of the sides vertical, so they will fit into the recesses in the board.

The PCB is mounted in the box on four 12mm-long M3 tapped spacers, using eight machine screws. Mark out and drill the 3mm holes for PCB mounting while you are making the holes for the cable glands.

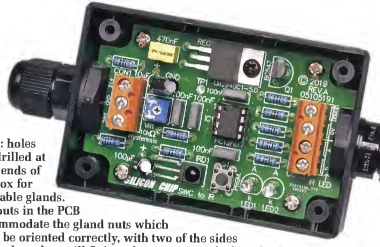


Fig.4: holes are drilled at both ends of the box for the cable glands. Cut-outs in the PCB accommodate the gland nuts which must be oriented correctly, with two of the sides vertical, so they will fit into the recesses in the board. The PCB is mounted in the box on four 12mm-long M3 tapped spacers and attached using M3 screws

Installation

The SWC Adaptor is wired into the vehicle so that it gets +12V power when the ignition is switched on. Virtually all head units have connecting wires carrying 0V (GND) and ignition-switched +12V, so you can tap into the supply there.

Just make sure the +12V wire has power with the ignition on and not with the ignition off.

The SWC input on the SWC Adaptor connects to the steering wheel control wire. You should already know where to tap into it from the previous test where you determined that your steering wheel controls are suitable for use with this unit.

The SWC Adaptor has two pairs of output wires: one pair to drive an external infrared LED (LED3) and another connecting to the collector and emitter of the transistor which provides the unmodulated output. You can use either to control the head unit. Each option has advantages and disadvantages.

The infrared LED approach has the advantage that the head unit does not need to be opened up; the infrared LED is simply placed over the infrared receiver on the head unit. The disadvantage is that the wiring to this LED, and the LED itself, will be visible.

The easiest way to do this is to use a premade IR Remote Control Extension Cable. These are available from Jaycar (see parts list). This has an infrared LED already mounted in a small neat housing, with a long lead.

You will need to figure out how to route that cable from the SWC Adaptor mounting location to the IR receiver on the head unit.

Adhesive wire saddles are useful for keeping this wiring neat.

The Jaycar IR extender has a 3.5mm jack plug which you can cut off, as it isn't needed. The LED anode wire is the one which was connected to the jack plug tip. You can also get similar extenders from eBay, AliExpress, Kogan etc, most of which have bare wire ends. Whichever one you use, wire it to the A and K terminals of CON2.

It's then just a matter of sticking the LED emitter package to the front of your head unit, directly in front of the infrared receiver, using its own self-adhesive pad.

If you do not know where the infrared receiver is, it will be in an area free from switches and knobs.

The front panel may have a purple-looking area over the infrared receiver, different in appearance from the rest of the panel.

If you still can't figure it out, you will need to test the unit while moving the transmitter around the panel until you find a location where it works reliably. You can then stick it in place.

Tweaking the button sensing

Once you have the unit wired up to power and the steering wheel controls, it is a good idea to perform some checks to make sure it is sensing the steering wheel buttons accurately.

The Adaptor button sensing input includes a 1kΩ pull-up resistor to 5V. This is shown with an asterisk both on the circuit and PCB. This resistor may need to be changed in some vehicles to give reliable button detection and discrimination.

To check it, monitor the voltage between TP GND and TP2 when the unit is powered up, pressing each steering wheel button in turn.

On our test vehicle, we measured 3.93V with switches open, then 0.383V, 0.708V, 1.11V, 1.59V, 2.2V and 2.98V when each of six switches was pressed individually. So we had reasonable steps of more than 300mV between each voltage. The unit's tolerance should then be set to half that value; in this case, 150mV or less. So we adjusted VR1 for 1.5V at TP1.

But we could have improved the voltage range if the 1kΩ resistor was changed to 510Ω. That would give 4.37V with switches open and 0.67V, 1.19V, 1.77V, 2.34V, 3.02V and 3.7V with each pressed individually. That would give us a minimum step of at least 500mV and so the tolerance value could be set to 250mV (2.5V at TP1).

But as long as the tolerance can be set to at least 100mV (ie, at least 200mV between the two closest voltage readings), we would consider that acceptable.

If your steering wheel control switches provide a voltage range that differs significantly from ours, you may benefit from adjusting the 1kΩ resistor value. If your voltage readings are mostly low, try using a lower value, while if your readings are all on the high side, try using a higher value. But don't go below 200Ω as you then risk damaging the resistors in your steering wheel.

Using the unmodulated output

The advantage of using the unmodulated output from the SWC Adaptor is that it can be wired internally to the head unit, so the wiring may be able to

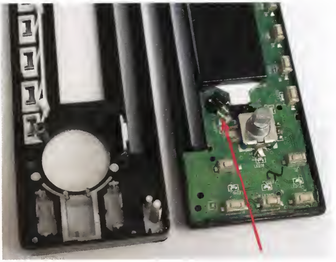


Fig.5 (above) shows the multi-way connector which is used to connect the front panel to the head unit.

Fig.6 (at right) shows the opened up the front panel of the head unit and the location of the infrared receiver (arrowed). But this is not the best location to connect the wire.

be hidden. Usually, only a single wire needs to be connected to the infrared receiver on the head unit. This wire can pass out the back of the head unit and routed to the SWC Adaptor.

The disadvantage of this approach is that you need to open up the head unit, find the infrared sensor output and solder the wire to it. How this is done is best shown in the accompanying photos.

In Fig.6, we've opened up the front panel of the head unit and located the infrared transmitted (arrowed). But this is not the best location to connect the wire.

Fig.5 shows the multi-way connector which is used to connect the front panel to the head unit.

To figure out which pin carried the infrared receiver signal, we plugged the front panel back into the head unit and opened its case, then located where the front panel connector is terminated (see Fig.7). We then powered it up using a 12V DC source and connected a DMM set to measure volts between 0V and each pin at the rear of the front panel in turn.

Look for a pin which measures around 5V, then measure its voltage while an infrared transmitter is placed in front of the unit and a button held down, so it is transmitting. If you have the correct pin, that voltage reading should drop slightly while the infrared remote control transmitter is active. In our case, we found that it dropped from 5V to 4.75V during infrared reception.

The arrowed pin in Fig.7 is the one that we determined carries the infrared signal, and this is where we soldered the wire.

You could use an oscilloscope to look for the pulses from the infrared receiver; however, the multimeter method is easier and generally works well.

The SWC Adaptor output includes a 0V connection for the unmodulated output. This can be wired to a ground connection on the same multi-pin connector. However, this should not be necessary as the infrared receiver on the head unit should have its ground pin connected to the head unit chassis and would be at the same potential as the 0V connection on CON1.

If you have problems with the unmodulated connection working, try connecting a wire between these two points to see if that solves it.

Setting up the unit

Now you need to decide what functions you want from each switch on the steering wheel. Typically, this would include volume up and down, source selection, next and previous file/track/frequency/station and power on/off.

You are not restricted to the original purposes of each switch, although it would be less confusing to do so. You can use each switch to perform any of the functions available on the handheld remote control supplied with your head unit.

For some buttons, you may want the function to repeat if held down (eg, volume up/down) but with others, you may not (eg, source selection or on/off).

We found that with some head units, holding down the source selection button would result in nothing happening. You would have to press the button only for a short period to switch to the next source. That's not ideal when using steering wheel buttons. So we have included a feature in the SWC Adaptor where two out of the 10 possible buttons will not generate repeat codes even if held down.

So it's just a matter of assigning functions which may have this shortcoming on your head unit to those two button positions.

This would generally include source selection, power on/off, radio band change or mute. None of these need the repeat function.

You can test whether this is necessary by holding those buttons down on your infrared remote control and seeing whether the unit behaves as desired, or not.

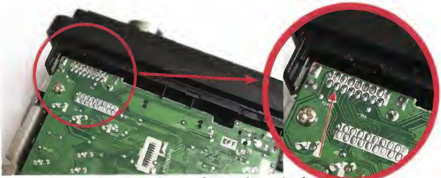


Fig.7: the arrowed pin in is the one that we determined carries the infrared signal, and this is where we soldered the wire.

Programming the button functions

You can now match up the voltages produced by each steering wheel button to the desired infrared function. You can program up to 10 switches. It does not matter what order you program each switch, and you don't have to use all 10. The non-repeat feature mentioned above applies to switches nine and 10, so you can skip some positions if you don't have 10 buttons but need this feature.

All of the programmed infrared codes must use the same infrared protocol (NEC, Sony and RC5 are supported – see overleaf).

That should not be a problem given that your head unit remote control will be using one protocol for all of its buttons – and most likely, one of those supported by this unit.

To enter the programming mode, hold down S1 while switching on the vehicle ignition. Entering programming mode clears any previous programming.

So you must program the functions of all switches each time this mode is invoked. Upon the release of S1, LED1 will flash once, indicating that the SWC Adaptor is ready to programming the first switch function.

Point the handheld remote toward the infrared receiver on the SWC Adaptor and press the required function button. LED2 should light up. If it does not, it is possible that your handheld remote does not use one of the three supported protocols. LED2 will light up continuously for codes received in the NEC protocol. It will flash off once and then on for the Sony protocol and flashes off twice for RC5.

Now press and hold the steering wheel switch that you want to assign to that function, then press S1 on the SWC Adaptor. The input voltage for that switch and the infrared code will then be stored in permanent flash memory for that switch position. LED1 will then flash twice, to indicate that the Adaptor is ready to accept the infrared code for the second switch function.

Continue programming each switch for the function required. Each time you press S1, LED2 will flash a certain number of times, indicating the next switch number that is ready to be programmed. You can press S1 again to skip a position that you don't want to assign (eg, if you have less than ten steering wheel buttons). Once the tenth position is programmed, the SWC Adaptor will stop and not respond.

Switch off power and when you then switch it back on again, without pressing S1 on the unit, the SWC Adaptor will begin normal operation, reproducing the stored infrared code each time one of the selected steering wheel buttons is pressed.

This also applies if you don't program all ten positions; merely switch off the ignition when you have finished programming all the functions that are required.

To use the special non-repeat feature at positions nine and ten, you can skip over the earlier positions using extra presses of S1 to reach them if you are not programming all 10 functions. **SC**

Parts List – Steering Wheel Control Adaptor

1 PCB coded 05105191, measuring 77 x 47mm
1 UB5 Jiffy box (optionally with flange)
1 3-way PCB mount screw terminal with 5.08mm spacing (CON1)
2 2-way PCB mount screw terminals with 5.08mm spacing (CON2)
1 DIL-8 IC socket
1 momentary SPST pushbutton switch [Altronics S1120, Jaycar SP-0600] (S1)
9 M3 x 6mm pan head machine screws
1 M3 hex nut
4 M3 tapped x 12mm spacers
2 IP65 cable glands for 3-6.5mm wire

Semiconductors
1 PIC12F617-I/P microcontrollerprogrammed with 1510519A (IC1)
1 LM2940CT-5.0 5V atomotiveregulator (REG1)
1 Infrared receiver [Jaycar ZD1952 or ZD1953, Altronics Z1611A] (IRD1)
1 BC547 NPN transistor (Q1)
2 3mm high brightness red LEDs (LED1,LED2)
1 Infrared Remote Control Receiver Adaptor Extender Extension Cable [Jaycar AR1811 or similar] with adhesive backing for direct mount over IR sensor (LED3)

Capacitors
1 100µF 16V PC electrolytic
1 22µF 16V PC electrolytic
1 470nF 63V MKT polyester *(code 473, 0.47 or 470n)*
4 100nF 63V MKT polyester *(code 103, 0.1 or 100n)*

Resistors (0.25W, 1%)
1 10kΩ *(code: brown black orange brown or brown black black red brown)*
1 2.2kΩ *(code: red red red brown or red red black brown brown)*
4 1kΩ *(code: brown black red brown or brown black black brown brown)*
3 100Ω *(code: brown black brown brown or brown black black black brown)*
1 10kΩ miniature horizontal mount trim pot (VR1) *(may have code 103)*

Miscellaneous
Automotive wire, solder, connectors, self tapping screws etc.

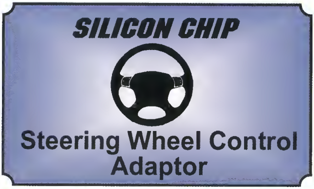


Fig.8: the front panel for the SWC Adaptor can be downloaded as a .pdf from our website and printed onto paper, transparent film or adhesive-backed vinyl. See www.siliconchip.com.au/Help/FrontPanels for details.