Tutorial – how to modify Nissan Skyline GTR R-33 headlamps to LHD projector units

There are two possible reasons to want to upgrade your R33 headlamps to use modern 'projector' lighting units :

(i) to have improved light output with a more modern headlamp appearance
(ii) If you live in a left-hand drive country like (France in my case), then this conversion will allow you to legally convert your headlamps to LHD spec.

Before I start with the nitty-gritty of how this is done, a short explanation of the types of headlamp technologies that we will be dealing with..

Most R33s have standard reflector headlamps – the exception is the final Series 3 cars that were equipped with original-equipment Xenon projector units. Reflector headlamps, as the name suggests, use a curved reflector to provide the beam pattern, using a halogen bulb (HX in the case of the R33) 'suspended' in the optical centre of the reflector. The beam pattern is designed into the shape of the reflector, therefore cannot be easily changed from RHD to LHD. Low-beam is provided by one of the reflector 'pockets' in the headlamp, high-beam by the other. In the R33, the low-beam unit is switched off when the high-beam is switched on. This technology was cutting-edge when the R33 was designed in the early nineties, but has been far surpassed by newer technologies since then. The R33 headlamps are pretty poor by modern standards, even poorer when the headlamp lenses have yellowed, and really diabolically poor when you add on beam deflectors (or beam 'benders') to make it legal-ish to drive in France..

So, we are going to be converting our headlamps to modern 'projector' units. A projector unit, instead of reflecting the light, uses a powerful collimating lens to focus an almost-parallel beam of light down the road. The light source – which can be a halogen bulb or a Xenon gas-discharge tube - is fixed at the focal point of this lens. A bi-halogen or bi-xenon projector is a projector unit that is capable of providing low-beam and high-beam by the same light unit. This is done very simply by having a small moving "shutter" inside the lamp, between the light source and the lens. The low-beam cut-off pattern is machined very accurately into this shutter, which is moved vertically up and down by a simple solenoid actuator. When the actuator is powered OFF, the shutter is automatically down, and the unit delivers a low-beam pattern. When the actuator is powered ON, the shutter clicks up in a few tens of milli-seconds, and the unit delivers a fuller high-beam pattern to throw the light further down the road. This is a very clever, relatively simple and very compact method of providing both low-beam and high-beam with one lighting unit. These types of headlamps are becoming very popular on high-end German and Japanese cars, and are even filtering down to relatively humble cars like the Skoda Fabia.

An important point – European regulations require that cars fitted with Xenon headlights have self-levelling adjusting systems, to make sure that they are always correctly adjusted, and hence do not blind oncoming traffic. As the gendarmes in France are rather picky about such things, I chose to fit bi-*halogen* projector units to my car, and non bi-*xenon*. Most of this tutorial is applicable if you chose to fit a xenon system; however you will also have to install the ballast units that power the xenon light sources. There is a lot of existing information on this on the Internet if you have a look around..

So, we are going to be replacing our 1990s reflectors with 2010-tech bi-halogens.. here we go.

Step 1 – assembling the bits

You will need :

1 Nissan Skyline R33

A spare set of headlamps if, like me, you are a big wuss and dare not cut yours up without a back-up!

4 bi-halogen projector units with shrouds and cabling

I sourced my projectors from the highly-recommended The Retrofit Source (TRS) (www.theretrofitsource.com) based in the US of A. Matt at TRS was very helpful and knowledgeable, and was able to recommend suitable units for my car. On his recommendation I went for the FX-R unit, original equipment on various Toyotas, and particularly suitable for conversion projects as it is very compact on all three dimensions. Matt also pointed me towards the E46-R shrouds. Reasonably priced at 350 USD all-in , fully delivered to France in about two weeks. Excellent service, I can't recommend them enough.

FX-R projector units with shroud and cable kit for high-beam shutter actuation

If you are on a tight budget you could try scrapyards, or e-bay for second-hand projector units from various cars like Infiniti G35, or the Hella units starting to be fitted to various VAG models.

Tools :

Nothing too fancy required – standard hand tools for the most part. You will need a Dremel or other cutting tool capable of cutting plastic precisely. You will need to round up various clamps, electrical components – more detail below in the electrickery part - a soldering iron, a rivet gun and a silicon mastic pistol. You will also need a 12V battery or, better, a 12V power supply.

You will also need a very high quality 2-part epoxy resin. I ordered an epoxy known as JB Weld, very well known in the US, but not in Europe. This comes in two forms – a liquid epoxy, and an epoxy putty that acts as a dual adhesive and filler. Both were very useful and are highly recommended. Here is a friendly source in Europe : www.jbweldadhesives.co.uk .

Tool-kit needed – big hot oven not pictured!

Any other good-quality epoxy like Sikaflex will also do the job. Check the maximum temperature rating – the projector units run hot, you need something that will hold over 200C. JB Weld is specified to hold 260C continuously. This compared to just 65C maximum temperature rating for Araldite, for example.

Step 2 – headlamp removal

Two ways to do this. The officially-approved way is to remove the lip spoiler, front undertray, wheel-arch liners and the whole front bumper assembly to get at the headlamps. A real pain, not easy to do even with new shiny fasteners, and most R33s will have rather tired bolts by now – you WILL break a few if you have not done this before.

A much faster way, and a really useful tip. Remove the front indicators in the lower bumper aperture – one screw and they just slide out. Undo the connector and put the parts safely to one side. Now lie on the garage floor and insert a hand up into the nether regions. You will find a 10mm bolt, pointing inboard, that screws into a weld-nut on the lower outer headlamp fixing. Flexible wrists, foul language and a bit of fiddling with a small ratchet will have it out in no time. Now undo the other bolt on the upper cross-member, and the two hard-to-reach screws holding the headlamp to the radiator frame. The headlamp will now slide out enough to undo the two electrical connectors. Undo them, and the headlamp is in your hands.

Remove indicator to get at hidden headlamp bolt

The proof – headlamp out, bumper still on!

Note that this does NOT work on cars that have larger aftermarket dump valves or oil coolers fitted in the spaces behind and below the headlights – you will simply not be able to get your hand in far enough to get at the bolt. Bumper off job in these cases, I am afraid.

Step 3 – headlamps disassembly

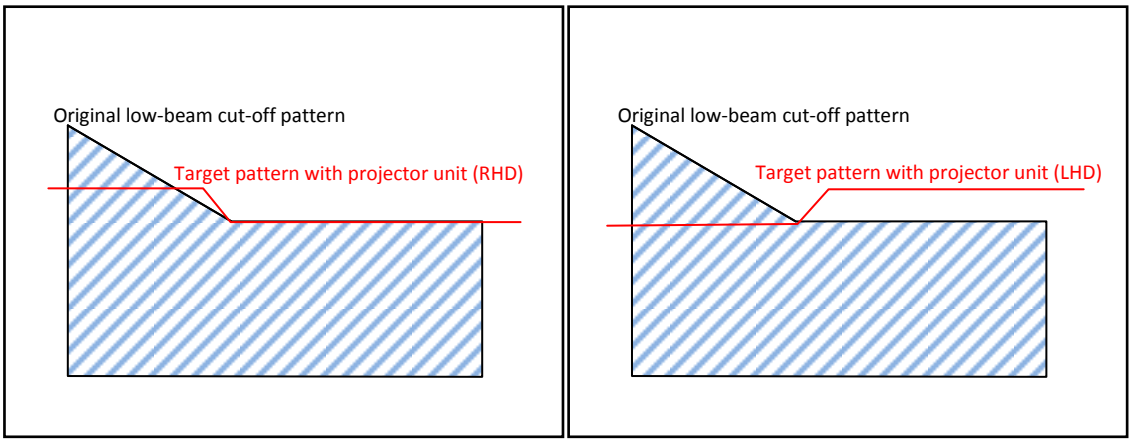
This bit is pretty well-documented elsewhere. Remove all the hardware from the projectors – bulbs, wiring harness, brackets, breathers, and the 5 spring clips that hold the lens to the main housing. Now heat your oven to 270C, and pop your headlamp on a COLD baking tray of grille in the oven for 7 minutes. This will partially melt the factory-fitted sealant. Remove the lamp with oven gloves, and carefully pry the lens away from the housing with an old knife and a pair of flat-nose screw-drivers. A helping hand is useful here. Go easy – the housing is close to its melting point and it will deform permanently if you are too aggressive or impatient. Once you get a gap opening near one of the corners, pull gently while 'cutting' at the sticky black mastic goo with the knife. Messy, but it works. While the two parts are still warm, use the screw-drivers/knife to scrape all of the old mastic out of the groove and off the lens edge. This is a tedious and dirty job, but the more of the old mastic you remove now, the better quality joint you can make later when re-assembling the lamps with a new bead of mastic.

In fact I found that my own domestic oven was too small to accept the full headlamp, so had to turn it around by hand like an unwieldy turkey. For my second headlamp, I heated it carefully in front of an open log fire – not recommended. This job can also be done with a heat-gun, but take care not to create hot spots.

Now that you have the headlamp open, you can remove and strip down the internal components – removing both reflectors and the black plastic mask from the back of the lens. To remove the reflectors, simply unscrew the horizontal and vertical adjusters all the way, and pull gently to pop the adjustment pivot out of its socket.

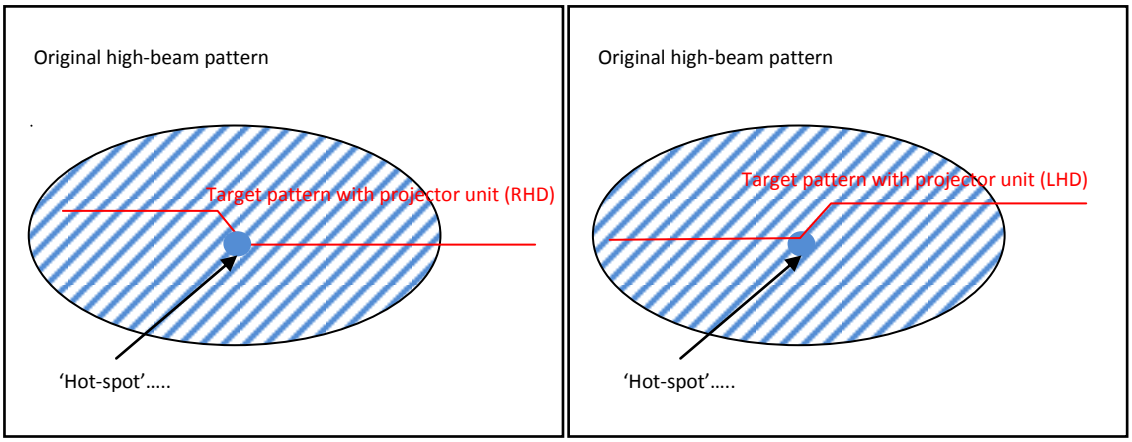
Step 4 – cuttin' n' shuttin'

Now the tricky bit. Clamp one of the reflector units to a solid workbench, facing across the workshop. This needs to be done very carefully – you need to be able to cut the reflector *without* unclamping it from the bench – so take some time to set this step up carefully. You will need various G-clamps and bits of spare wood to chock the reflector solidly in place. Now refit the bulb, connect it to a 12V battery or power supply, and shine the light across the workshop onto a wall – preferably 3m or more away to get a clear pattern. Turn off the workshop lights and mark the beam pattern on the wall using duct tape. The low-beam reflectors will show a classic 'cut-off' shape as shown in the diagrams below.



You will be trying to aim the new projector unit to replicate this pattern. Of course, if you are converting from RHD to LHD, you will be aiming to replicate this pattern 'flipped' or mirror-image of itself. Got that ?

For the high-beam reflector units, the pattern will be more of an oval, without a clear cut-off, but with a clearly-visible 'hot spot' that marks the beam centre. You will be aiming to place the lower edge of the cut-off as close as possible to this hot-spot – see the diagrams below!



Now, take your Dremel, fitted with a plastic-cutting wheel. Cut the reflector gradually, bit by bit, to accept the projector unit. The projector unit needs to sit to that the bulb spade connectors sit roughly in the same position as the original. You will need to cut a large aperture in the lower surface of the reflector in order to slide the projector in place. A circular hole will need to be cut in the rear part of the reflector's parabola. See photos to visualise this.

Cut reflector – this is the lower surface....

Needless to say this took many hours of trial and error, slowly chipping away the plastic with the plastic cutting disc and grinding stone. Safety glasses and face-mask *de rigueur*, of course - the process generates a lot of very fine white dust. Try not to allow this into the projector unit, by the way - you do not want dust particles on the inside of that projector lens…

Luckily you will find that the flat upper surface of the projector lines up very well with the upper surface of the reflector. I took advantage of this to fix the projector by rivets. Take great care in drilling the projector – you must not damage the solenoid coil, or allow metal drill swarf to fall into the housing.

Next step is to glue/epoxy and rivet the projector permanently in place. Don't forget to key the mating surfaces to be glued with the Dremel – scrape off the metallisataion on the reflector and rough up the surface to be joined. Keep every thing spick and span at this stage. Mix up the epoxy strictly according to the manufacturer's instructions. Apply it sparingly to the inside of the reflector around the hoe you have cut. Apply a thin layer where you have drilled the holes for the rivets. Now place the projector in place, protecting the wires for the shutter solenoid with shrink-wrap or electrical tape to avoid the wires rubbing against the cut edge of the reflector body. Rivet the lot together.

Ready for gluing...note surfaces keyed to aid adhesive bond

Here I found that the JB Weld putty came in very useful, filling the gaps between the reflector and the projector unit with a sticky but malleable epoxy putty that dries to a very hard solid surface. Again, highly recommended.

Leave the assembly to dry overnight in a warm dry room.

Glued and riveted unit…

As soon as the unit is dry, it's time to fit the shroud. I found that I had to cut approximately 20mm off the lower edge of the shroud in order to fit into the headlamp housing, allowing space for the displacement of the unit's vertical adjustment. The reflector also has to be trimmed to allow the shroud to fit snugly onto the projector unit without rubbing on the reflector unit. Again, trial and error and careful measurements BEFORE applying the Dremel.

Before fitting the shrouds in place permanently, I applied some matt black plastic paint to the parts of the reflector that will be partially visible though the front lens.

Glued and riveted unit – rear view. Note grey JB Weld putty filling the gap between the hole cut in the reflector and the projector

At this stage, I found that a lot of time can be saved by making paper templates of the holes to be cut out on the other headlamp. When you come to do the second headlamp, just flip them over and trace the shapes to be cut out on the reflectors. This will save a lot of time…

Now you can fit the shrouds permanently – just a light coat of epoxy resin on the insides of the retaining ring, and press them gently into place. Again, let it dry

overnight. Now you have a fully prepared projector unit – just 3 more to go !

Cut shroud, ready to glue in place

Once you have converted all four reflectors to projector units with shrouds fitted, you can carry out a trial fit of the units into the headlamp housing. This will allow you to measure up two things (i) the parts of the black headlamp mask that need to be cut back and (ii) how to arrange the wires to connect the headlamp high-beam actuator shutters.

To measure the mask, adjust the headlamp units to the fully UP and fully DOWN positions. You want to cut back the plastic material of the mask (carefully!) until you have a few millimetres clearance to the units when the mask will be refitted in the right position. This is to ensure that you will have the full mechanical adjustment range without any interference. However, you do not want to remove too much material or the finished job will be rather unsightly. Again, little by little on the first headlamp, then use paper templates to reproduce the cut-lines much more quickly on the second headlamp. Finish the cut edges with a grindstone and fine wet-and-dry sandpaper.

Trial assembly - showing shutter actuator wires in place, adequate clearances between shrouds and housing

The high-beam shutter wires need to be arranged carefully within the headlamp to make sure that they will not be trapped when the units are adjusted. You also need to be able to access the connector. I found the easiest way was to cut the connector off the outboard projector, and to solder the wires into the connector of the inboard unit. There is no risk in doing this, as the current that is passed is just a few hundred milliamps – a single connector is quite capable of powering both units. As usual, make neat solder joints and tape them up carefully.

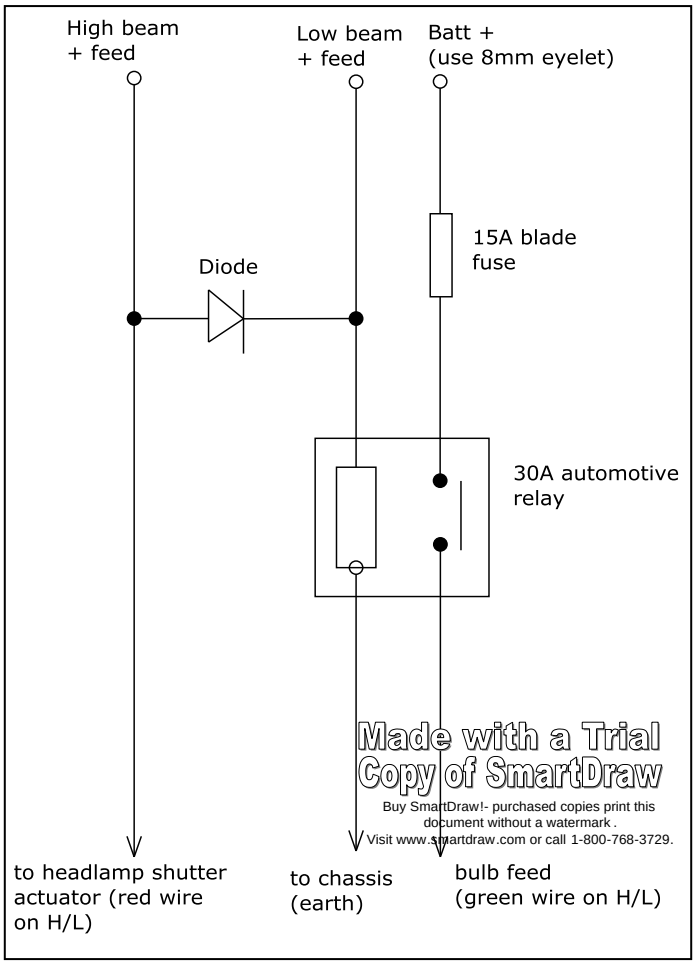
Now is the time to turn your attention to the yellow old headlamp lens. Again, this step is pretty well documented elsewhere. In short, use progressively finer grades of wet-and-dry sandpaper, T-Cut and finally glass polish to buff the lenses up to a clear transparency. Refit the black mask using the four screws.

Now you are ready to re-assemble your headlamp – a big moment. Using a mastic gun and a steady hand, apply a smooth bead of plain black silicone mastic to the groove in the headlamp housing that you cleaned out so well before. Ideally, pop it back in a hot oven for 2 or 3 minutes to allow the plastic and remnants of old mastic to warm up. Now place the lens in place and press the lens and housing firmly together. Replace the 5 spring clips and scrape/wipe off any excess black ooze. Let the whole assembly dry overnight.

Almost done now. Refit the external hardware – brackets and breathers. If like me, you need to be legal, you will need to fit H7 bulbs into the projector units. This is easy but fiddly – you need to grind a few mm off the diameter of the 4 bulb bases in order to fit. More careful Dremelling called for…

Step 5 - Electrickery.

First you will need to modify the small wiring harnesses that clip onto the headlamps. You need to feed both headlamp bulbs off the green low-beam wire – carefully make a T solder joint to run both lamps when low-beam is turned on. You also need to adapt the harness to run the red wire into the positive (red) feed to the high-beam solenoid actuator connector. For this you will need to drill a small hole in the waterproof headlamp caps to run a feed into the headlamp. Seal the hole carefully with a bead of epoxy resin. The black wire is t-eed into the black earth wire that also provides the earth path for the bulbs.



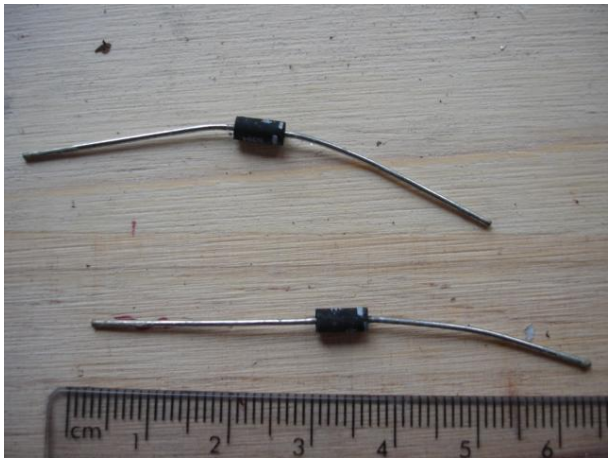
Now you need to modify the engine bay harness. As low-beam will now be running 4x55W of power as opposed to the factory-original of 2x55W, the current running through the light-switch (the right-hand stalk under the steering wheel) will be doubled. This will probably work OK for a while, but risks burning out the switch contacts in the long-term. I therefore choose to install two relays – one for left, one for right, with the relay contacts fed direct from the battery via 15A blade fuses. The relay coil is fed direct from the head-lamp low-beam wire. To do this, simply cut the wire where it comes out of the engine bay harness behind the headlamp. Join in a new length of wire and feed this into the positive side of the relay coil. The negative side of the coil connected to ground (chassis) using one of the convenient earthing points near the washer-bottle mounting points. The relay contact (or output) is then linked to the cut end of the headlamp wire. Now when you turn on the low-beams, only the relay command current (typically 130mA x 2) will

Relays and fuses neatly installed in engine bay relay/fuse box

run through the light switch, causing the relay contacts to close and the full lighting current to flow direct from the battery to power the lights. Neat.

Just one snag remains. The Nissan lighting switch is designed to mechanically open the low-beam switch when the high-beam switch is closed. So, power is lost to the relays and you will have no lights ! There are several ways to counter-measure this - it can be done by installing more relays or (allegedly) by bridging links on the back of the light-switch stalk. I chose to do it with diodes, which seems to me a simple and elegant solution. To do this, you need to solder a diode from the high-beam feed to the low-beam feed. In this way, when the high-beams are turned on, the diode will allow current to be fed into the relay coil, keeping the contacts closed and the lights on. As the relay command currents are low – 130mA or less – there is no need for bulky, expensive power diodes. I used IN5399 diodes, rated at 1.5A continuous current, but still small and hence easy to solder into the harness.

Relays and fuses were installed in the existing relay/fuse box behind the washer-bottle, using some of the 'spare' places thoughtfully provided by Nissan. Cables were run carefully in, protecting them with spiral wrap and securing them in place regularly with tie-wraps. The diodes were soldered into the harness just behind the headlamps.



IN5399 diodes ready for soldering…

Now, connect everything up. Re-install the headlamps. Light 'em up, stand back and admire!

Final step – adjustment. For a rough adjustment, I copied the beam pattern from another car, allowing for the different heights of the R33. For a more accurate adjustment, you will need to pass by a friendly garage equipped with a headlamp aiming board.

Before…

And
after….