[Mirrors]

# Remote Control Repair

Contents:



[Document Version: **2.20**] [Last Updated: **9/16/96**]

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# 1. About the Author & Copyright

**NOTES ON THE TROUBLESHOOTING AND REPAIR OF HAND HELD REMOTE CONTROLS**

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# 2. Remotes, remotes, and more remotes

Fifteen years ago, a wireless remote control was a $50 or $100 option (in 1980 dollars) to a TV or VCR. Early remote controls used ultrasound or radio frequency analog transmission and could perform only limited functions - you were lucky to get anything beyond on/off, volume, and channel up/down. Today, a remote control is standard with even the lowest cost basic electronic equipment. Nearly all modern remote controls use Infra Red (IR) light for digital data transmission. Some have more buttons and functions than a personal computer! Unfortunately, many have row upon row of tiny identical size buttons with no logical layout of functions. Others are a masterpiece of ergonomic engineering almost operating by themselves.

There are two kinds of problems with remotes:

1. They seem to have legs of their own and disappear at the most inconvenient times.
2. They get abused by being dropped, dunked in Coke or beer, chewed on by the pet tiger, or left alone to develop dead leaky batteries.

While there are some remotes that will respond to a whistle and beep back to identify their location, most are the ordinary deaf, dumb, and blind variety. I cannot help you locate your missing remotes. If you have disappearing remote syndrome, a well designed universal remote - on a tether - may make a good investment.

Most actual problems with remotes can be solved relatively easily. They are often of a physical nature. Since remotes operate on low voltages under non-stressful conditions, spontaneous electronic failure is relatively uncommon. The following are not good for remotes: Sitting or stepping on them, using them as drink stirrers, door stops, projectiles for target practice, substitutes for dog bones, or depositories for your old leaky batteries.

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# 3. Testing of remotes

First, confirm that your problem is not simply due to a selector switch in the wrong position or an accidental press of a key selecting 'VCR' instead of 'TV'. If your 'broken' unit is a universal type, make sure it has not simply forgotten its programming or codes - reinitialize it. A common cause of memory loss is the batteries falling out or losing contact for an instant due to a fall or bump.

Next, try to determine whether the problem is indeed in the remote itself and not the TV, VCR, CD, or other controlled equipment. The easiest way to do this is to temporarily program a universal remote to match your equipment. If this now operates successfully, then you can be pretty certain that the problem lies in the remote unit.

If you are not able to get a universal remote to operate your equipment, then either you have not found the proper code setting or the remote itself is indeed faulty (or you don't have a universal remote!).

Should you or a friend has an identical or nearly identical piece of equipment, try the (faulty) remote on that (and its remote on your equipment) as a further test.

If you have multiple pieces of equipment, make sure you have not accidentally substituted an apparently identical remote for a slightly different model VCR, for example. Not all equipment - even of similar type - from the same manufacturer necessarily use the same signal transmission format.

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# 4. Diagnosing the problem

To narrow down the problem, use an IR detector to determine if the remote is emitting an IR signal when each button is pressed. While this does not guarantee that the signal is correct, it eliminates most common problems from consideration. An IR detector card or an IR detector circuit like the one at the end of this document are very handy for testing remote controls and other IR emitters. Some camcorders are sensitive to IR as well and will show a bright spot of light if aimed at a working source of IR.

Modern remotes use a pulse code modulated carrier to send the command. A typical carrier frequency is 40 KHz with each pulse consisting of multiple cycles (e.g., 20 for each bit) of this carrier. For buttons that repeat, typical rates are 10-20 Hz and the entire code may actually be sent only when the button is first pressed with only a 'repeat' code sent while it is held down. The carrier frequency and coding schemes have apparently not been standardized and vary quite a bit even from the same manufacturer. Therefore, it is beyond the scope of this document to enumerate them all. It is possible to see these types of waveforms with an oscilloscope by monitoring internal signals of the remote including certain pins on the main IC as well as the LED or its driver

or across the transistor of the IR detector circuit (see the section: "IR detector circuit"). The salvaged IR sensor module from a TV or VCR may also be used as an IR detector. These usually operate from a single supply (12 V typical) and output a clean demodulated signal (you will not see the carrier, only the 1s and 0s).

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# 5. Problems with remotes

Most problems occur in the hand units due to the abuse inflicted on them by kids, pets, and even otherwise well behaved adults. However, the equipment or even outside interference can also be at fault. Therefore, also see the sections: "Problems with the equipment" and "Problems due to interference".

The following are the most common types of problems and suggested solutions. As noted, most are physical in nature: dead batteries, gunk, bad connections.

For all but (1) and (2), disassembly will be required. Manufacturers seem to be using more and more creative (read: obscure and difficult to open) methods of fastening the two halves of the remote shell together. There may be a screw or two and/or the case may simply 'crack' in half by gently prying with a knife or small screwdriver along the seam or sliding the two halves a fraction of an inch to unlock some catches. Look for screws inside the battery compartment and hidden snap fasteners.

**Dead batteries**
: Solution obvious. If batteries tend to go dead quickly - the batteries in a remote typically last years - then you may have a stuck button, some conductive grime under one of the buttons, or a defective IC - or you may be using cheap batteries.

**Corroded battery contacts**
: Clean off the chemical deposits - first dust out the dried material with a soft brush and then remove the remainder with a damp lint free cloth or paper towel. Polish the contacts with a pencil eraser and/or very fine sandpaper or a nail file. If there is evidence that the battery juice made its way inside the case, you will need to open the remote and thoroughly clean the interior.

**Broken or intermittent contacts**
: There are most often between the battery connections and the circuit board. Carefully resolder and reinforce them if necessary. There could also be cracked solder joints on various component pins (particularly those that get abused like selector switches) as well. Reflow the solder on any suspect joints.

**Broken Ceramic Resonator**
: These may fail from shock when remotes are dropped. If you have an oscilloscope, check for signals on the IC when buttons are pressed - if there is no action on any pin, then you may have a bad resonator (or bad IC, etc.). Monitoring on one lead of the ceramic resonator should produce a signal at the carrier frequency when a button is pressed. A typical waveform may be around 40 KHz with an amplitude of a few tenths of a volt. A ceramic resonator usually is a small blue or orange object that looks similar to a plastic or dipped capacitor. The circuit board marking will be X1 or CR1 or something like that. Replacements may be available from places like MCM Electronics or other electronics distributors. Or, consider an organ donation from a remote for equipment that has long since gone to that entertainment center in the sky.

**Dirt/spills/gunk**
: This may cause circuit problems preventing keys from operating reliably or physical problems resulting in keys being just plain stuck or sticky. Disassemble completely and wash both sides of the rubber membrane keypad, circuit board, and plastic case with water (and mild detergent if necessary to remove sugar based grime) and then isopropyl alcohol - dry thoroughly.

**Worn or corroded pads on circuit board**
: These may be interdigitated or semi-circular patterns and suffer from both wear and corrosion. Conductive Epoxy or other similar conductive paint or ink may be used for repair. A piece of thin copper foil can be glued to the circuit board and soldered to the appropriate circuit trace. (Gold foil would be better as it will not corrode but might be just a tad pricey for a $10 remote!)

**Worn conductive material on rubber buttons**

Compare the bottoms of frequently used keys with those that are rarely pushed. If you can see the rubber through the conductive material after cleaning, the pad is likely worn to the point of being non-functional. This may be repaired with conductive Epoxy or other similar conductive paint or ink. A sliver of aluminum foil can sometimes be glued to the rubber surface. 3M makes EMI/RFI foil shielding tape, type 1181, that should work very well for this.

MCM Electronics at 1-800-543-4330 lists a Rubber Keypad Repair Kit for $24.95. It is supposed to contain enough material to repair 200 contacts. Their part number is 20-2070. Not cheap but 200 contacts covers quite a few typical remotes.

Occasionally, the conductive material is not actually worn off entirely only on the surface and there may still be some beneath surface. Light sanding may help.

(From: Paul Weber (webpa@aol.com)).

"If you're looking for aluminum or copper foil tape with adhesive on it, visit your local hardware store, in the plumbing and/or roof rain gutter sections. Alternatively, try an auto parts store. I've found a variety of adhesive foils (including stainless steel) in these kinds of establishments.

As for as repairing conductive rubber keypads: I've not used the metal tape method, but will probably try it. I've had great success with a thorough cleaning and light buffing of the contact area with very find (1000 grit) wet/dry sandpaper."

**Cracked circuit board**

These can be repaired easily as the circuit boards are usually very simple, single sided, and have wide traces. Use Epoxy or an adhesive like Duco Cement or windshield sealer to repair and reinforce the circuit board. Scrape off any insulating coating and jumper breaks with fine wire and solder. Do not just bridge the gaps with solder as cracks and future problems are a certainty.

**Bad IR LED**

Test the LED(s) with an external power supply and IR detector and/or monitor voltage across them while operating. Substitute a visible LED and see if it lights up when keys are pressed. Use a scope to monitor the drive to the LED. You should see the pulse code modulated carrier. If faulty, replace with a readily available high intensity IR LED.

**Bad IC**

If the remote uses a custom chip, throw it away! This is usually quite unlikely unless struck by lightening. Even accidentally inserting the batteries backwards (though definitely not recommended!) - which tends to kill many devices - may not cause any harm to a remote. Check each pin on the IC with a scope to determine if it is at least alive.

(From: Duane P Mantick).

"An awful lot of IR remotes use IC's from the same or similar series. A common series comes from NEC and is the uPD1986C which, incidentally is called out in the NTE replacements book as an NTE1758. A lot of these chips are cheap and not too difficult to find, and are made in easy-to-work-with 14 or 16 pin DIP packages. Unless you have no soldering or desoldering skills, replacement isn't difficult."

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# 6. Alternatives to repair

There are a large variety of preprogrammed universal remotes available starting at $10. These are set up by inputting a code number for each type of equipment you will be using - TV, VCR, Cable box, etc. Don't loose the instruction manual or you will not know what codes to use if the batteries go dead or the remote looses its

memory for any reason! Record the codes in pen on a label on the back of the remote and inside the battery compartment. For general TV/VCR/cable use, the $10 variety are fine. However, they will not provide special functions like programming of a TV or VCR.

Universal 'learning' remotes are available at slightly higher cost (perhaps, $25-100). The better ones are capable of memorizing all of the actual signals sent by your original remotes by viewing the IR transmission directly. Of course, your existing remotes must be working properly for teaching purposes. Make sure you get a money back guarantee with these as some may not be compatible with all equipment. The advantage of a learning remote is that it can be taught to perform setup, adjustment, and programming functions as well as those for normal operation. However the teaching process is likely to be tedious and time consuming and you will have to keep track of which buttons do what - possibly not worth the effort in the end. If the backup batteries should ever go dead, the entire learning process will need to be repeated.

Don't even think about going to the original manufacturer for an exact replacement - they will want to charge you an arm and a leg (or more). However, places like MCM Electronics do stock a variety of original remotes - prices range from $9 - $143 (Wow $143 for just a stupid fairly basic remote! It doesn't even have high definition sound or anything exotic. You can buy an entire VCR these days for less than $143 including its own remote!), The average price of these replacements is a still rather inflated $40.

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# 6.1) Problems with the equipment

While circuit problems with the hand unit discussed in the section: "Problems with remotes" are most likely, the following causes should not be overlooked:

**Dirty IR window**

The plastic sheet which covers the IR detector may be coated with dust, grease, grime, or tobacco smoke, or other wise damaged. If sensitivity has decreased even with a new set of batteries, this is a distinct possibility. It is not always obvious whether a particular type of dirt or damage will affect response. Some condensation may be totally opaque to IR while appearing transparent to visible light. On the other hand, I have a TV where someone must have cleaned the sensor window with sandpaper or a strong solvent - it is totally clouded over but works just fine with my $10 universal remote.

Test by removing the front panel if possible and direct the remote at the sensor directly. Inspect and clean the sensor window thoroughly with mild detergent and water.

**Defective IR sensor, receiver electronics, or microcontroller**

This can result in the equipment simply ignoring you and/or doing whatever it pleases. The first two of these can generally be tested without service information. However, if they check out, advanced troubleshooting will be required.

Borrow a replacement or universal remote to determine if the device responds with a known good unit. Check demodulated waveforms with an oscilloscope to confirm proper signal levels and reliable operation. See the section: "Diagnosing the problem" as well.

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# 6.2) Problems due to interference

Symptoms for the following may range from no, intermittent, or incorrect response, to the equipment being possessed - a TV changing channels, volume, or powering itself on and off as though being controlled by a poltergeist.

These are likely possibilities if you have just changed your room layout or added something to it:

**Interference**

Interference from another remote in the same room which is defective (or is being squashed by a gorilla). Make sure there are no other IR transmitters including those like the a VCR+ or remote repeater that might be activated accidentally due to faulty programming or something pressing on the buttons. Do you know where all your remotes are hiding?

Cover the sensor of the misbehaving equipment with a piece of black tape to see if the problem goes away. Then round up your other remotes and discipline them!

**Fluorescent lamps using electronic ballasts**

These may be newer ceiling fixtures or the energy efficient compact fluorescents used as replacements for the regular light bulbs in table lamps. The electronic ballasts are switching power supplies and these may result in modulation of the light intensity at high frequencies confusing the remote control receiver.

Turn off all fluorescent lamps to see if the problem goes away. A cardboard baffle can be taped to the sensor to block the interfering light. Try a different brand of compact fluorescent as not all cause interference.

**Bright lights in general**

Enough ambient light, be it from the Sun or a 1000 W flood may overload the sensor. Ceiling fans can sometimes modulate the light with their fan blade rotation or vibration of the filaments of the bulbs which can confuse the remote control receiver and microprocessor.

Turn off the lamps or move the Sun <g> to see if the problem goes away. A cardboard baffle can be taped to the sensor to block the interfering light. Simply changing the orientation of a lamp shade or slightly moving one of components may be all that is needed.

**Electrical interference from nearby equipment.**

Inadequate shielding in the sensor electronics could result in susceptibility to RF emissions from other gear.

Turn off suspect devices. If the problem goes away, they will need to be moved to another location. Shielding is probably not a viable option.

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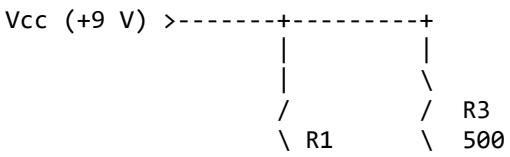
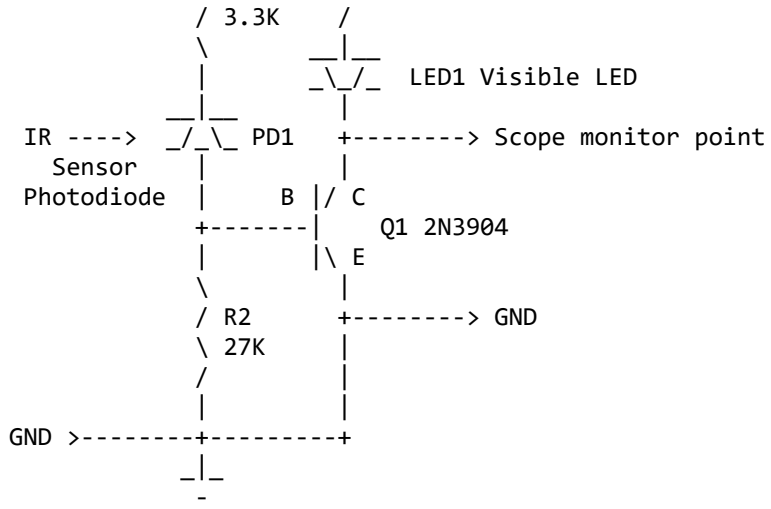
# 7. IR detector circuit

This IR Detector may be used for testing of IR remote controls, CD player laserdiodes, and other low level near IR emitters.

Component values are not critical. Purchase photodiode sensitive to near IR - 750-900 um or salvage from optocoupler or photosensor. Dead computer mice, not the furry kind, usually contain IR sensitive photodiodes. For convenience, use a 9V battery for power. Even a weak one will work fine. Construct so that LED does not illuminate the photodiode!

The detected signal may be monitored across the transistor with an oscilloscope.



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# 8. Malik's simple and cheap IR tester

(From Malik (M.dad@mmu.ac.uk)).

If you have a IR remote TV in the workshop for testing VCRs and other video equipment, you can modify this so that audio can heard from the speaker which represents the IR signal.

Simply couple the output of the IR receiver (in the TV) to the input of the audio output stage. Use a low value ceramic cap and a high value resistor, this should be possible on all remote TV's and will cost you next to nothing.

(What a nice idea! The only concern I would have is that not all IR transmitters use the same modulation frequency so I don't know how forgiving the demodulator in the IR receiver would be. Thus, you might think a remote control is bad when in fact it is just incompatible.

You could probably learn to recognize the codes by ear after a while as well! :-) --- sam)

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# 9. Paul's quick and dirty IR transmitter tests

(From: Paul Grohe (grohe@galaxy.nsc.com)).

Here is a another "quick" and "very dirty" test of the IR emitter I have used:

Clip a *glass* encased diode (1N34, 1N914, 1N4148, etc.) between your scope probe tip and ground clip. Crank the scope sensitivity up to about 20 tp 50mV/div. Hold the diode by the grounded lead (to reduce noise pickup).

Point the "business" end of the remote directly at the clear part of the diode body. The IR packets will now be visible on the scope.

You may have to move the remote around to find the "hot spot" in the window. The more of the diodes junction that is exposed, the better the response.

A Sony remote generates about 50mVpp with a typical 1N4148/1N914 and more than 200mVpp with a "wide open" 1N34A point-contact Germanium (at 1 cm).

BTW, the time constant of this setup may mask the actual 40KHz carrier pulses. Place a 100k resistor in parallel with the diode to see the individual pulses clearly (sensitivity **IS** reduced).

Or just simply hold the remote against an AM radio for a quick test.

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*Written by Samuel M. Goldwasser. [Feedback Form] [mailto]. The most recent version is available on the WWW server http://www.paranoia.com/~filipg/ [Copyright] [Disclaimer]*