



Hands-Free CB Radio Committee Report

Bryan Katz, Gary Kornstein, Paul Whittaker
Rose Stipanitz

with appendices addressing all physical and technical aspects of
CB installation



Hands-Free CB Radio Committee Report

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¹ Originally published in the file library as Pat Bellamy's December 2013 article entitled *CB Antennas: What's best for the Miata?*



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The Hands-Free CB Radio Committee was established at the February 2, 2019 Executive Meeting of the Trillium Miata Club to research and recommend options for CB radio equipment that meets the requirement to use only devices that are hands-free while driving.

There are a number of club members who drive alone and some of whom are either leads or sweeps; positions that require instructing other members of the group while driving. There are other drivers, who while they may have a passenger that could operate the radio, choose not to do so. Licensed Amateur (Ham) Radio Operators have a temporary exemption from the regulations that may expire as early as 2020. If the exemption is not extended Hams may have to operate hands-free

Most CB transceivers use a separate hand-held microphone or are a one piece transceiver in a slightly larger microphone like package which has to be hand held while transmitting and as such are contravening regulations, and as distracted drivers cause more and more accidents, police are likely to clamp down on Trillium Tour operators that are communicating in an entirely different way.

The Committee consists of:

Bryan Katz,
Gary Kornstein, (licensed Amateur)
Paul Whittaker, chair, (licensed Amateur)
under the general direction of Rose Stipanitz

Amateurs were invited to participate because of their knowledge of and familiarity with radio transceivers and related equipment. Members will be consulted from time to time and anyone who has an interest and wants to contribute is welcome.

The Committee has a budget of up to \$500 to purchase suitable equipment for testing. Although there is no established time line, the Committee is committed to researching, testing, evaluating, reporting and recommending suitable alternatives to meet the goal of hands-free radio operation before the Club's 2019 Touring Season begins.

Early in the proceedings Gary set out the following guidelines:

I'd like to open the discussion with a couple of points that I think we all agree on but if not please voice your opinion and supporting arguments;

- We are looking at equipment suitable for installation into any Miata to be used by a single driver (or driver who's companion is not comfortable using the radio)
- We want it to work with the top down
- We recognize that this is a noisy environment
- We recognize that most club members have very limited knowledge of radio theory or electrical know-how.
- Any solution must meet the hands free law definition so that it is legal to use by anyone.
- With all that in mind , my conclusion is that;
- Voice operated transmit activation (VOX) won't work therefore a physical push to talk switch is needed.

- The microphone has to be worn in some fashion in order for it to be close enough to one's mouth for reasonable clarity of transmitted audio.
- Speaker audio is typically sent to a single ear piece which is suitable when there are no passengers but we may want to explore how an external speaker might be added for those that prefer one.
- There are only a handful of CB brands out there (Cobra, Galaxy, Midland, and Uniden) some of which may use the same 4-pin microphone connector.

So my conclusion is that the most reasonable solution to the hands free issue is that a readily available (for most but not all models) 'break-out' box can be purchased for about \$50-\$75 that will allow one to swap the existing speaker microphone for a headset that has a microphone and speaker. The push to talk switch can be fastened by velcro to the gear shift .

I'm sure there will be issues to tackle in implementing any solution and I look forward to hearing everyone's thoughts.

Following Gary's early email outlining a reasonable approach discussions ranged widely exploring things such as using other personal radio services. GMRS or FRS (Family Radio Service in the United States) FM radios don't suffer from the kind of propagation difficulties that afflict the 11 meter (CB) frequency band. The problem is that these radios don't have sufficient range. The possibility of using other more modern services was explored. Gotenna for example cannot be used because it is restricted to the transmission of text and GPS co-ordinates. After looking at other radio services we came to the conclusion that CB radio best meets our requirements.

The Committee soon focused solely on hands-free microphone systems that could be used by all CB radios with a 4 pin microphone connector and that incorporate a PTT (Push To Talk) switch. Most club members already have radios that can accept such microphones. For those who have radios that cannot use an external microphone, there are reasonably priced CB radios undergoing tests and evaluation.

There are many hands-free microphones available but almost all of them are not specifically designed for CB radios. These have physical compatibility issues mostly to do with connectors. Another deficiency with all of these is that there is no provision for PTT (Push To Talk). Electrical incompatibility such as impedance matching, signal voltage, and other not yet anticipated problems take all of these out of the equation.

Only two hands-free microphone systems met all criteria. See the following two pages for a description of these Cobra brand microphones. The first is a wireless Bluetooth model, the other a wired microphone. The wireless version has been discontinued by the manufacturer but can be obtained on line at a sale price of about \$100.00 US less than the original list price. We don't know how many of, or for how long, these will be available. The wired version sells for about the same price as the wireless sale price. It is simpler, is not subject to possible battery failure but does have a wire that has to be dressed to keep it out of the driver's way. Both of these microphones require power and there is one wire that needs to be connected to the 12 VDC + supply. Grounding for both the wireless and wired microphones is through the radio's ground system.



Cobra Item # CA BTCB4
Self-contained Bluetooth Wireless Hands-Free Headset Microphone.

- Bluetooth Wireless Microphone System Designed Specifically for CB Radios
- Compatible with all 4-pin microphone connector CB Radios
- One-touch, Hands-free Protocol
- Rechargeable
- Adjustable for either right or left ear headphone
- Can also be used with all Bluetooth enabled cell phones

One-of-a-Kind Wireless Microphone System for most 4-pin CB Radios allows safe hands-free wireless one-touch communication for up to 10 hours of talk-time on one charge. Complies with the requirement for hands free operation. Premium noise canceling design, and easy installation. The package includes a USB cable and an automotive accessories socket USB plug for charging. The earphone only receives "beeps" from the junction box to convey status when in CB mode and audio from Bluetooth enabled cell phones when in cell phone mode. CB audio is heard only from the internal CB speaker or an external CB speaker and not through the headphone.

This may be the best way to transition to Bluetooth for your cell-phone if you have an older car not already equipped with Bluetooth. The microphone can be worn over the head or around the back of the neck with the microphone on either side.



**Cobra Item # CA MS4
Self-Contained Wired Hands-Free Microphone.**

- Microphone System Designed For CB Radios
- Compatible with all 4-pin microphone connector CB Radios
- One-touch, Hands-free Protocol
- Can be worn over the head or around the neck with microphone from either left or right side
- PTT can be operated by foot (with Automatic Transmission, possible but not recommended)

This microphone system for most 4-pin CB Radios allows safe hand-free wireless one-touch communication. It complies with the requirement for hands free operation. Premium noise canceling design, and easy installation.

Each of the jacks on the control module are of a different size to ensure that the correct plug is inserted into the correct jack.

The microphone can be worn over the head or around the back of the neck with the microphone on either side.

Testing In the Real World and Recommendations

These microphones should meet the requirement to communicate hands-free using CB radios while driving. On April 25, 2019 initial trials were conducted while testing an upcoming tour. Four cars participated, all using CB radios. Two were equipped with Cobra CA MS4 wired hands-free microphones the others with traditional hand held microphones.

Gerry Robbins chose to wear his over his head which he says, helps keep his hat on. Paul Whittaker on the other hand preferred wearing the headpiece around his neck. Both of these options are promoted by the manufacturer. The results?

The audio quality of this microphone is high with fidelity almost beyond expectations for CB radio. However the positioning of the microphone is important. The received audio from Gerry's transmissions was consistently at the same level while Paul's varied as his headpiece, worn loosely around the neck, moved. This resulted in those receiving his messages having to adjust their volume control. A way to keep the microphone in the same position is imperative. Further trial and testing is required.

Initial impressions by the users are that these microphones are better than expected. Paul considers his new setup (Uniden Pro 510 XL w/ Cobra CA MS4) to be far superior than his previous Cobra 75 WX ST hand held radio/microphone. This had to be removed from a clip and sometimes was not returned to the clip leaving the radio to move around the cockpit resulting in much flailing and frustration. The other problem with this particular set up is that the channel up / down switches are just above the P.T.T. resulting in an unintended channel changes. The squelch and volume controls were awkward to adjust on the go. It's much easier to have a radio fixed in a stable easy to reach position where controls fall easily to hand.

With his new radio Paul finds that the squelch and volume is easy to adjust while driving without having to look at the radio; i.e., eyes are on the road. The P.T.T. Is wrapped around the gearshift column just under the knob, easy to reach and hold with the thumb while driving and even while shifting gears.

Gerry really likes his new microphone. In Gerry's case there was no need to change radios since his has the standard four-pin microphone connector. All Gerry had to do is provide power to the microphones junction box by connecting the lead from the box to the 12 V + (red) line. Not having to pick a microphone up, hold it and put it back makes a big difference when driving. Steering and shifting gears is enough to do while driving. Gerry appreciates that. Wearing the headset over the head makes sure the microphone doesn't move which means that output is consistent. In Gerry's setup the P.T.T. Is located on the hand brake. His gearshift lever is really too short but he can make really fast shifts, he just can't transmit while shifting.

Our initial experience with the wired hands-free microphone is that it exceeds expectations and more than meets the requirements of drivers who wish to use their CB while driving to conform to distracted driving regulations. The Cobra CA MS4 wired hands-free microphone is recommended.

The wireless Bluetooth version was tested on May 4th while driving the "Season Opener". This unit has the same microphone and P.T.T. arrangement as the wired version. However, the head-piece is different and rather than a wire from the microphone to the radio, Bluetooth technology is used. Paul found that this unit is more comfortable to wear over the head but is otherwise the same as the wired microphone. The Cobra CA BT CB4 wireless hands-free microphone is recommended.

Appendix A: Microphone Wiring and Compatibility Chart (Adapted from CB World page)
<https://www.wearecb.com/cb-microphone-wiring.html>

If you already have a CB radio and wish to purchase one of the two Cobra hands-free microphones, check the list below to ensure it will work with your radio. Not all microphones are wired the same way. For example, just because two different microphones are four pin does not mean that they are wired the same, even if they are the same brand! Different manufacturers may wire their microphones differently. Generally, a radio manufacturer will wire their microphones the same so that the microphones are interchangeable between their radios, however, this is not always the case.

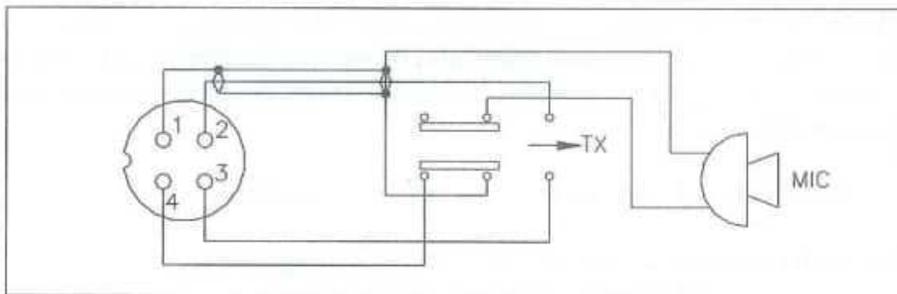
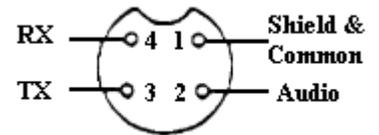
For example, Cobra four Pin radios are wired 1) Shield; 2) Audio; 3) Transmit; 4) Receive; while most Midland four Pin radios are wired 1) Audio; 2) Shield; 3) Receive; 4) Transmit. There are some radio brands that have the same general wiring (such as Cobra and Uniden) but that is not always the case.

The list below offers some CB microphone wiring information. CB microphone wiring can be frustrating enough, but when you can't find the right wiring information, it is just impossible.

CB Radio Microphone Wiring Diagram:

4 WIRE MIC CABLE

<u>Pin Number</u>	<u>Mic Cable Lead</u>
1	Audio Shield
2	Audio Lead
3	Transmit Control
4	Receive Control



The chart and image above are correct for the CB radio models listed below making them compatible with either of the Cobra Hands-Free microphones:

Galaxy CB Radios

- | | |
|-------|-------|
| DX919 | DX979 |
| DX929 | DX44V |
| DX939 | DX55V |
| DX949 | DX66V |
| DX959 | DX77V |

Cobra CB Radios

19 DX IV
148 GTL
18 WX ST II
19 DX IV Camo
25 LTD
25 LX
25 NW LTD
25 WX NW ST
29 LTD Chrome
29 LTD Classic
29 LTD DE
29 LX
29 LX Camo
29 NW LTD
29 WX NW ST

Midland CB Radios *

1001LWX
5001
9001Z

* Other Midland radios may not have the same microphone connector pin configuration.

Contact Midland to find out at:

<https://midlandusa.com/>

If the pin assignment on your radio's microphone connector is not correct a club member with the appropriate skill set can modify if for you.

Uniden CB Radios

PC68ELITE
PC68LTW
PC68XL
PC78ELITE
PC78LTW
PC78XL
PRO505XL
PRO510XL
PRO520XL

Appendix B: CB Radios That Meet the Requirements of the Hands-Free Microphone Committee

This section is for those of you who have to purchase a new radio to replace an existing radio not compatible with the recommended hands-free microphones or for those who have yet to purchase a CB radio for Trillium Club touring.

The Committee considered the following when choosing radios:

- Microphone Connection - Standard 4 Pin
- Size - The radio needs to be small
- Simple - Using KISS as a guiding principle, radios having only the basic essential controls and features were considered
- Economical - reasonably priced
- High reliability and service rating (as reviewed by users)

RECOMMENDED: The radio that most closely meets all of the requirements is the Uniden PRO 510XL Pro Series radio which retails for \$53.00 CDN. This radio has a higher power audio output than other CB radios but is equal to all others in its RF output which is mandated by government regulations to be the same in all CB radios. It has a dual conversion receiver and a unique PLL (phase lock loop) frequency control system.

Controls are simple. There's only four:

- an ANL (Automatic Noise Limiter) off/on switch - for eliminating such things as ignition noise.
- an off/on volume control.
- a squelch control - to eliminate unwanted RF (Radio Frequency) signals and/or interference.
- a channel selector (rotary; right up, left down, channels 1 through 40)

Displays are simple. There's

- TX (transmit status indicator)
- LED S/RF (Signal received/Radio Frequency power transmitted) meter
- Channel Display

There is a built in speaker under the radio and a jack on the rear apron for an external speaker, a SO-239 antenna socket, and a long pair of wires with a 2.A line fuse for connection to the car's 12 VDC power. A hanger/mount bracket and dynamic microphone are included with the radio. An in dash single DIN panel adaptor is available for those who have NA or NB cars with an empty DIN slot and space to hang the hands-free microphone adaptor and are looking for a permanent mount.

*This radio is 4.500" W x
6.750" D x 1.375" H and
weighs 1 lb., 9 oz.*



THE COBRA 19 DX IV MEETS MOST OF THE REQUIREMENTS. This is a similar sized radio to the Uniden. It has an RF gain control and a switch for Channels 9 / 19, not considered necessary features. It also has the PA (Public Address) function, not useful for Trillium Club applications. It lacks an ANL switch which may be an important feature and consideration when making a decision to purchase. The price is \$49.95 US, only \$2.00 more than the US price of the Uniden model recommended, so it is competitively priced. This radio is available from GPS Central for \$68.00 or Radio World for \$85.00.

This radio is slightly larger than the Uniden measuring 4.500" W x 7.000" D x 1.750" H and weighs less at 1 lb., 3 oz.



THE MIDLAND 1001LWX MEETS MOST OF THE REQUIREMENTS. This too is similar in size to the Uniden and Cobra but it is more expensive at \$69.95 (USD) and is available on Amazon at \$87.51. The radio has PA function and there is an RF gain control concentric with the volume control. It also features NOAA (National Oceanic and Atmospheric Administration) weather scan, which automatically tunes the strongest weather signal when WX is selected. More knobs and features, less simplicity but some may consider the weather channels to be an advantage.

This radio is about the same size at 4.875" W x 6.500" D x 1.500" H. Weight is 1 lb., 10 oz.



GALAXY makes a fine line of CB radios but all are much larger than the Cobra, Midland and Uniden models described above which may be problematic for installation in a Miata. They also include features and controls that complicate operation without improving communication. We are aiming for less distraction. None of the Galaxy CB radios currently available meet the established criteria for Trillium Touring although they could be used. They have an appropriate microphone jack for the hands-free Cobra Microphones.

Appendix C: Mounting CB radios

Now that you have a new hands-free microphone, perhaps you should consider the placement or mounting of the CB transceiver. Some of you have had to buy a new CB because the hands-free microphone could not be used with the old radio. In either case the following needs to be considered:

- The CB should be securely mounted so that it cannot move when the car is motion
- Controls can be easily reached without having to shift position while driving
- The display(s) can be easily seen.
- The CB can be removed easily when not needed leaving no trace that it ever existed
- Any mount should be inexpensive and easy to make and implement

Many mounts and mounting systems have been used in all series by individuals who are very creative. Some place the CB behind the passenger seat. Some mount the radio on the back of the console. In many cases the radio has become part of the car and is always there ready to use. The following are just examples of how to mount radios in NA/NB, NC and ND series.

NA/NB MOUNT

If you have a NA or NB there is a simple mount that you can make yourself with materials and tools that should be at hand. This mount will work with any of the radios described on the previous pages. The price is right and when completed the radio will be in the right position to adjust, see, and it can be easily removed.

This mount places the radio on the right side of the centre console just a bit in front of the gear shift. It fits between the left side of the passenger side floor mat and under the edge of the console. It slides in from the front and remains secure until removed by sliding it forward.

Material:

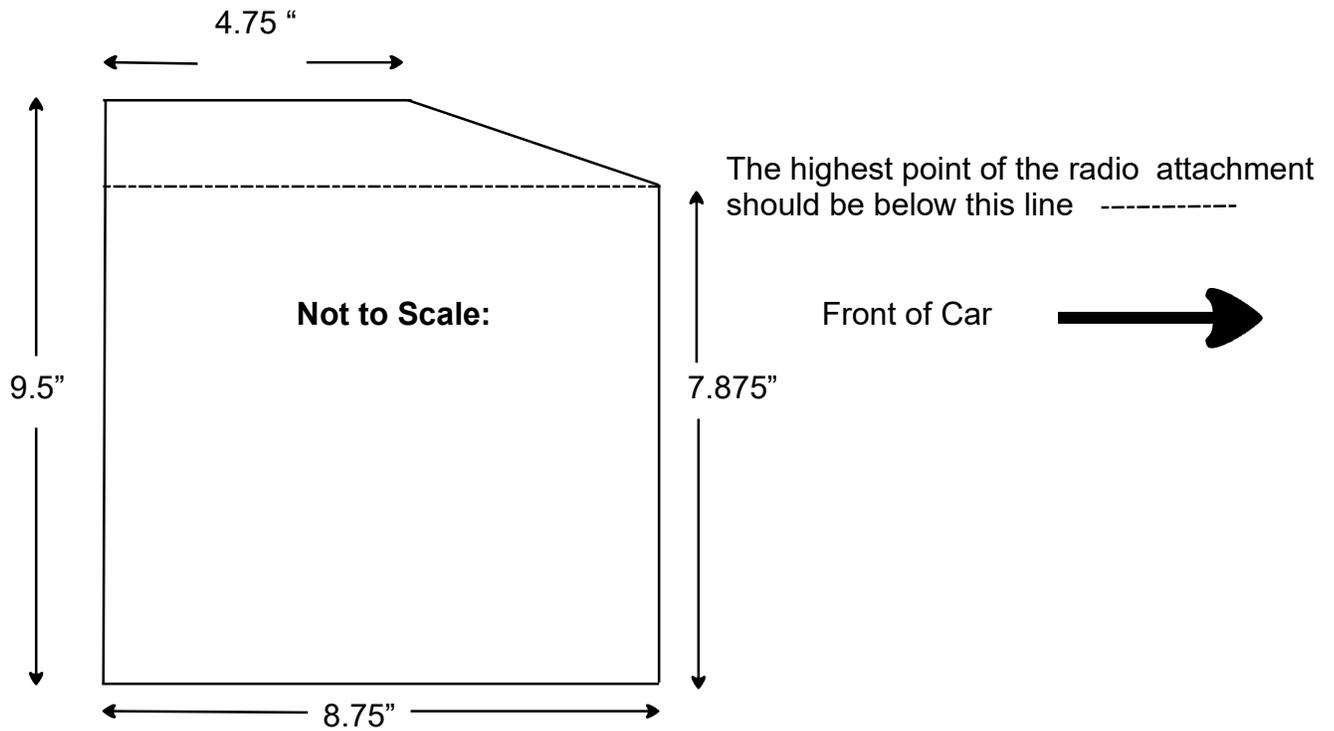
- corrugated cardboard
- nuts and bolts
- duct or similar tape
- leather, leatherette, vinyl, or cloth (optional)

Tools:

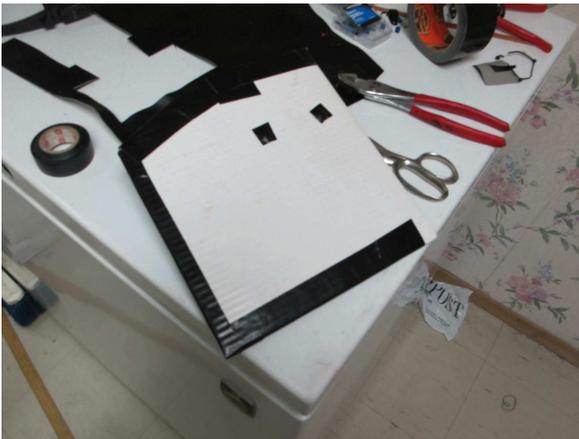
- Scissors
- Ruler
- Pencil
- drill or something to make holes (not in the car, in the cardboard)
- screwdriver; wrench or pliers.

A single piece of thick corrugated cardboard can be used, or two pieces of thin corrugated cardboard will work. If using a single piece orient it so that the corrugations are vertical on the finished piece. If two pieces are used, orient each piece so that one is vertical and one is horizontal.

The size and shape of the completed mounting board is exactly the same as the twin cup holder available from MOSS MIATA. If you have one of these, simply place the cup holder on the cardboard, draw a line around the base and cut the cardboard around the outside of the lines, ensuring that the corrugations are vertical if using a single piece. If you don't have one of cup holders, you can either borrow one to draw the outline of your mount or use the following as a guide.



Locate the transceiver as far to the left as possible without overhanging the side of the mounting board. Apply tape around the edges to keep out moisture and to protect the edges against tearing. A vinyl, leather, or cloth covering hides the cardboard and conveys a professional appearance. It will look like it really belongs in your Miata.



The CB radio mount under construction, and the radio mounted in position in the car. The PTT, antenna, and power lines have yet to be connected.





The PTT switch is fastened to the gearshift knob with a velcro strap. The extra wire is stuffed between the seat and the radio. The switch, operated by the thumb is really close to the brake handle when shifting between first and second gear.



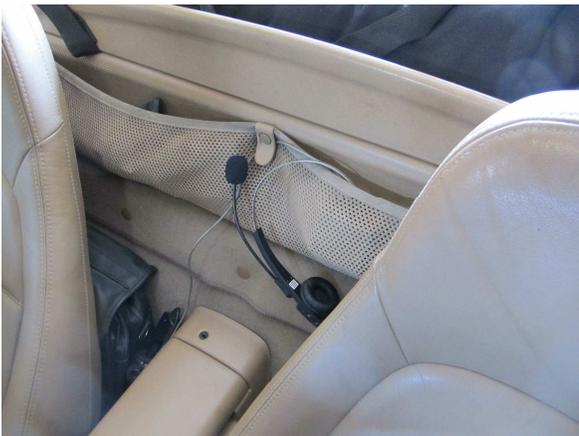
In this installation the fused power line terminates with a quick disconnect (female for the ground and male for the positive) at the panel behind the passenger seat near the seat belt spool trim. These disconnects are crimped on the end of wires connected to the battery with a line fuse on the + wire.

The accessories socket could be used making providing power easier but in this case the socket is occupied by a swatch watch mount making this option impossible.

Even if this accessories socket is free, there is a problem with using the socket in this car because it is powered down when the ignition is off. The radio's power needs to be connected when the radio is turned off for it to maintain the channel selected. Removing power when the radio is off resets the channel to 1. This could be problem when returning to your car after a bio-break. You might forget to select the channel used by your group.



This radio uses the wireless Bluetooth microphone which requires recharging. A NOCO GC018 12V Plug Socket w/Eyelet



Terminals extended with 12 AWG wire and connected directly to the battery provides power for recharging. The socket is located close to the passenger's seat belt latch; out of the way but readily accessible.

When not in use, the hands-free microphone hangs from the wind blocker net. The external speaker is hidden away in the net and the wire connected to the transceiver can be seen. This is just one example of how a CB radio can be fitted in and removed from NA and NB Miatas without having to drill holes or leave a trace when the radio is not in the car.

NC MOUNT

These are just two examples of simple mounts. The first one is Carol Burrow's installation of the CB on the right side of the transmission tunnel. In her example, cords are used to keep the radio in position. A triple accessories socket provides power for the radio allows for two additional pieces of equipment to be utilized.



The second one is Ed Preston's installation of the CB also mounted on the right side of the transmission tunnel. The radio is oriented towards the passenger and is kept in place by a large piece of self adhesive velcro obtained from Canadian Tire. A remote speaker also held in position by velcro is mounted high between the seats.



Others have mounted radios behind a seat.

ND MOUNT

The mount developed by Gary Kornstein for the ND series is simple to make, install, and remove. The CB radio is positioned in the left side of the passenger side of the console over the alternative cup holder. In this installation poster board rather than corrugated cardboard is used because it doesn't need to be covered and protected from moisture and the surface has an appropriate "finish".

The radio is the same Uniden PRO 510 XL installed in Paul Whittaker's NB and the mount is similar in concept, i.e., it utilizes a cup holder position, is inexpensive, easy to make, and safely keeps the radio in place.



Before starting the mount: the CB transceiver with the stock microphone, mounting bracket (not shown in this picture) with added accessories socket plug, and owners manual; Cobra CA MS4 wired hands-free microphone with junction box; and, poster board used to fabricate the CB radio mount. This is all that is needed (except of course for the antenna system, which is beyond the purview of this report and the Hands-Free CB Radio Committee).

The poster board fits in the cup holder hole. The size of the cut is the width of the hole (about 2 inches) and it is 7 inches high. The shape is not a rectangle but rather something like a triangle on top of a rectangle.

The mounting board with the CB mounting hanger in position shows how easy it is to install a CB radio in the ND without having to drill holes in the car.

The three pictures on the following page show the completed installation.

1) Position of the radio, the break out box and radio rear apron connections.

2) PTT on the gearshift, CB radio on the console right side and the hands-free microphone on the dash.

3) Completed installation showing power source for the CB radio and the GPS device.





Appendix D: Sources of Equipment and Supplies

This section lists the best sources found at the time of writing for equipment described in this report. This doesn't mean that the Club guarantees these to be the best or only sources, just that members of the committee used these sources and found them to be useful. The links will take you directly to the pages:

Hands-Free Microphones

Cobra CA BTCB4 Hands-Free Wireless (Bluetooth) available for \$125.58 from Amazon Canada; *
https://www.amazon.ca/gp/product/B00APUYSTE?pf_rd_p=5a1aedcb-634e-416c-9e4d-99f483cdf00&pf_rd_r=G5HWD5GM5AZX51YMJ4WH

Cobra CA MS4 Hands-Free Wired available for \$37.50 from Amazon Canada;

https://www.amazon.ca/Remote-Mount-4-Pin-Microphone-System/dp/B0051AIUM4/ref=sr_1_fkmr0_1?keywords=%E2%97%8F+Cobra+CA+MS4&qid=1552495212&s=gateway&sr=8-1-fkmr0

This item is unavailable at the time writing and don't know when or if this item will be back in stock*

CB Radios

Uniden PRO 510XL *Pro Series* available for \$53.00 from Amazon Canada;

https://www.amazon.ca/Uniden-PRO510XL-40-Channel-CB-Radio/dp/B00004VXNF/ref=sr_1_fkmr0_1?mk_fr_CA=%C3%85M%C3%85%BD%C3%95%C3%91&crd=1KSZYLWYYW0IV&keywords=uniden+pro510xl&qid=1552495505&s=gateway&prefix=%E2%97%8F%09Uniden+PRO+510XL%2Caps%2C187&sr=8-1-fkmr0

Cobra 19 DX IV. This radio has PA (Public Address) and RF gain control, additional features that don't contribute anything and it is more expensive at \$88.06 than the Uniden PRO 510XL. It is available from Amazon Canada.

https://www.amazon.ca/19-DX-IV-Display-channels/dp/B01KH31KEE/ref=sr_1_1?keywords=Cobra+19+DX+IV&qid=1554644735&s=gateway&sr=8-1

Midland 1001LWX. PA and NOAA (National Oceanic and Atmospheric Administration) weather scan are included in this radio. More features that don't contribute anything to our communications but might be worth having. This radio is \$104.06 and it too is available from Amazon Canada

https://www.amazon.ca/Midland-1001LWX-Radio-Weather-Scan/dp/B00176RNLA/ref=sr_1_fkmr0_1?keywords=Midland+1001LWX&qid=1554645087&s=gateway&sr=8-1-fkmr0

Radioworld have these radios in stock at slightly higher prices but they do not sell the Cobra hands-free microphones. Microphone systems they do have, do not easily adapt to CB radios.

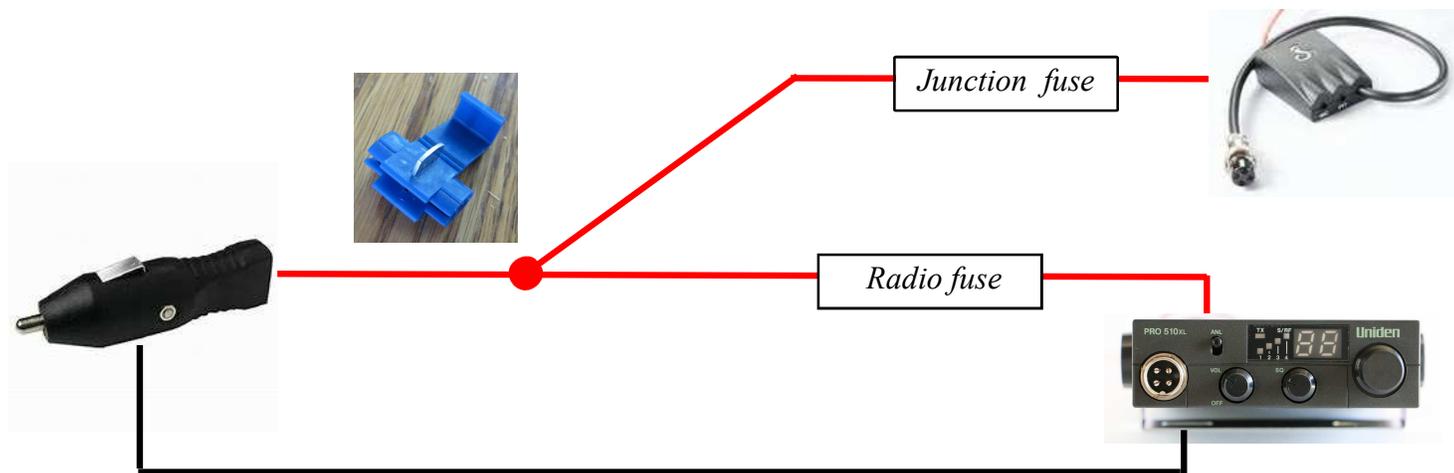
On-line sellers such as <https://www.rightchannelradios.com> can provide advice as well as CB radios, microphones, antennae and related equipment.

Wire, connectors and fuses can be obtained from Canadian Tire, Princess Auto, NAPA, UAP, Walmart and other similar locations.

* July 29, 2019

Appendix E: Wiring; Powering your Equipment

The simplest way to power your radio is to use an accessories plug that fits into your "cigarette lighter" or accessories socket. However you can't just plug your radio in; both of the hands-free microphones require power. Here's one way that can be accommodated.



- Note that the splice for the two power positive (+) red lines is located between the power source and the device's line fuse.
- The blue connector shown above does not require that insulation be removed from the wire. Just slip the radio's red line in the slot, and the end of the junction box wire in the hole that passes beyond the metal clip and close it with pliers.
- The red wire goes to the centre conductor of the accessories plug. The black wire to the outside clip.
- Do not plug your radio's power supply in until the antenna has been connected to the radio.

The above is for those without experience or knowledge of electrical systems. I will leave connecting your radio directly to the car's electrical system to those who know how to do it or are getting someone else to do the job.

Appendix F: Antenna Types, Location, and Mounting by Pat Bellamy

I'm often asked about what makes a good CB set up for the Miata. It really boils down to three things: The radio, the antenna, and the quality of the installation. Of these three, the antenna (and it's state of tune) plays the most significant role.

Nearly all mobile CB antennas that I'm aware of operate at $\frac{1}{4}$ wavelength for the 27 MegaHertz band (the Citizen's Band). Off the shelf CB radios put out something approaching 4 watts of RF power (the legal limit), so the antenna has to be pretty good to get the most of the meagre power available. Mobile radio installations, for small sports-cars in particular, require a fair amount of compromise (height and position of the antenna, size & location of the radio, etc). A quarter wavelength for CB is roughly 9 feet long, making a mid-ship mounted and well tuned 9 foot fibreglass whip the best hope for maximum ERP (Effective Radiated Power) - can you imagine how a Miata would look with such an antenna? If you don't own a big 4x4, a 9 footer is probably not going to look right on your vehicle.

For practical reasons we can't really entertain having an antenna mounted on the roof (soft top) or on the bumper (non-conductive plastic bumper cover) - this leaves the rear deck (or deck lid) as the most popular choice of real estate for antenna mounting. For those who garage their car, or for those with obvious aesthetic misgivings about wearing a 9 ft whip on their Miata, there are a number of solutions available - I'll discuss the relative merits of each in due course, however it's important to understand that all of these 'compromised' antenna variants are physically shorter than $\frac{1}{4}$ wavelength and so each is electronically doctored in one way or another to make the radio 'believe' that the antenna is still a quarter wave or 9 ft long.

Antenna manufacturers typically utilize RLC circuits or loading coils to create more practical mobile applications. What's RLC Pat? RLC circuits incorporate resistive, inductive, and capacitive components which form a tuned circuit. The important thing is that any and all of these additional items inevitably cause a certain amount of loss in terms of radiated power. The better the design & quality of these components, the less 'lossy' they will be. The less missing antenna length these components are making up for, the better radio range (receive & transmit) you can expect to get. Height matters, although keep in mind convenience - you don't really want to have to take off the antenna every time you enter a parkade or your own garage, do you? If we establish that 36-48" is about all the sensible height we have to play with, then what's available for mounting on our Miata deck lid? Read on for Pat's recommendations, but first a brief word about SWR.

Simply put, SWR (Standing Wave Ratio) is the ratio of forward power (the power emitted from your radio) to reflected power (the power uselessly reflected back to your radio, due to poor tuning, rather than out into the air giving you more range). Ideally, you want your system tuned to give an SWR of 1:1, the first digit being the reflected power. In mobile applications this ideal is rarely met although it's often possible to get 1.5:1 or a bit lower. A reading of 2:1 or higher can eventually overheat your radio's final output transistors, so I recommend getting someone you know with an SWR meter to help set things straight. It's also important to note that if you're using a removable antenna, such as a magnetic mount, that you reliably put it back as closely as possible to the same spot it was tuned at to maintain the best tuning.

The following chart lists antenna types and the pros and cons of each type.

Here are Pat's picks for the best Miata friendly antennas - any mention of brand is simply coincidental - with what's readily available in the GTA region:

TYPE	PROS	CONS
<p>Best: 4 ft fibreglass whip (Firestik and the like). Using direct mounting hardware</p>	<ul style="list-style-type: none"> • The loading coil runs the entire length of the antenna which is a less 'lossy' proposition than compact coils found in base loaded whips. • Provides better bandwidth i.e., good resonance across all 40 channels. • No additional RLC components required. 	<ul style="list-style-type: none"> • Often comes in component form i.e.: separate purchases of whip, mount, coax cable & spring, (if needed). • Some do not have tunable tips which means a bit of cutting will be needed to tune them. • A 3 ft version will have less bandwidth at low SWR, but may better suit your space constraints.
<p>Almost as Good: Base loaded, direct mount, stainless steel whip (Wilson 'Lil Wil', K30, and the like).</p>	<ul style="list-style-type: none"> • Good quality, everything you need in one package. • Tunable for low SWR across at least 10 channels using an allen key, or in some cases a file to cut down the whip section. • 36" height means it can stay on the car at all times. Longer versions like the Wilson 1000 and K40 will work better. • at the expense of convenience & price. • Arguably looks better than the fibreglass whip mentioned above. • Mounts to the trunk lip, or by drilling somewhere on the rear deck. 	<ul style="list-style-type: none"> • Reduced bandwidth and increased coil losses compared with the above.
<p>Good: A magnetic mount version of either of the above.</p>	<ul style="list-style-type: none"> • Works fine for most people in a car club tour scenario. • Easily removed when desired. • No holes to drill or pointed grub screws to tighten through the paint. • use a mag mount 'Lil Wil', it works very well. 	<ul style="list-style-type: none"> • Direct grounding is preferable for maximum signal strength and reliable SWR. Mag mounts are, as the name implies, magnetically grounded. • SWR may drift if the antenna isn't reliably replaced in the same spot. • Can slide and otherwise damage paint finish over time.
<p>Adequate: Jackson Splitter (uses the car's broadcast receiver antenna).</p>	<ul style="list-style-type: none"> • Provides adequate range under most car club circumstances. • Easily tuned for near perfect SWR across a wide bandwidth. • Complete stealth - uses a traditional AM/FM radio whip in the standard location. • Allows car radio & CB to share the same antenna. 	<ul style="list-style-type: none"> • The most expensive option listed • Potentially higher RLC losses than all of the above. • Installation is trickier than off-the-shelf CB antennas • Some CB manufacturers recommend that this type of antenna should be avoided. Consult your Owner's Manual.



Left: This popular type of antenna mounting bracket fastens to the hardtop securing bolts. Both right and left hand versions enable CB antennas to be mounted on the opposite side of the car to the broadcast receiver antenna.

Below: When removed, the antenna remains on the bracket and the whole assembly stores in the the trunk. The RF cable is threaded through from the trunk to the cabin where it can be connected to the CB radio.

A slightly larger version of the bracket shown here on a NB fits NC soft-tops. There isn't an equivalent mount for the NC PRHT or for either version of the ND.



Above left: Since the bumper is plastic this antenna mounting location suffers from the lack of a ground.

Left: Black Beauty has its antenna fastened to the front lip of the trunk lid. This is a good position for a mount but the antenna can't easily be removed. Rose seems perturbed as Cathi and Mike mess with the radio installation. Yes it WAS Cathi's car, but it now belongs to Rose.

Below: Anything between the magnet and the car body may protect the car's finish but isolates the antenna which requires a physical ground. Although it may work, it doesn't work well and the antenna cannot be tuned.



Right: The minimalist approach adopted by Gary K utilizes a mag mounted "Rubber Duckie" which is essentially a coil the length of an 11 metre quarter wave enclosed in a rubber sleeve. Much easier to store than longer antennae.





Left top: This ND RF utilizes the tow hook accessible by removing a small circular cover in the bumper to mount the antenna. This provides a secure mount with a good ground although the antenna is lower than it would be if mounted on the top of the body.

Left centre: This is one of the few places where a mag mount can be placed on the ND roadster.

Below: This mag mount placement works as long as the top is up. This is a good position because it is high and almost in the centre. However, like all mag mounts, the bodywork suffers.



Left and right above: These mag mounts with a protector between the mount and the car body are not the best for RF (Radio Frequency) propagation although the screen protector (left) may be better than cloth or other material. Nevertheless transmissions on Trillium tours are typically very short and distances between radios is short enough that less than ideal set-ups are acceptable and work well enough for tour operations. Communications between separate groups may be more effective if conducted by those having low VSWRs and a properly grounded antennae.

Appendix G: Antenna Tuning and Help Setting Up Your Equipment

Once you have your radio and antenna installed there's more that needs to be considered and done. The antenna, the piece of wire that seems the simplest and most insignificant, is the most important. Component. It has to resonate at the right frequency and match the impedance of the radio. Rather than explain this just take my word for it. Your antenna is important and tuning your antenna is important. If your antenna isn't properly adjusted it can do significant damage to your radio, you won't hear other operators clearly and the range of your propagation will be restricted.

Special equipment and experience is needed to set up antennae. All CB antennas are "tuned" at the factory, but in real life situations that isn't really good enough. There are ideals that are theoretical goals but in most installations there are compromises that must be accepted. What will work best in each application depends on many parameters but a setup the meets most of the requirements can usually result in the physical part of a working communication system.

Licensed Amateur Radio Operators (HAMS) Pat Bellamy sabian@sympatico.ca, Gary Kornstein Garyjoe@hotmail.com, and Paul Whittaker paul_whittaker@rogers.com, all have specialized measuring equipment, knowledge, and experience required to set up your antenna. Pat also has the skills and tools required to make necessary modifications to radio equipment.



These Antenna Analyzers are used to determine an antenna's resonant frequency, SWR, impedance and make a number of other antenna performance measurements.

These devices can be connected to a computer with the appropriate software installed for graphic analysis and will provide more information and data than anyone really needs to know about an antenna system. The CB radio is not connected and is not part of the antenna analysis.

The much simpler and cheaper SWR (Standing Wave Ratio) meter is more awkward to use and provides less information but can be useful for tuning an antenna. The antenna as well as the CB radio needs to be working and connected while using a SWR meter.

