BY ROY GARDNER • SUPERIOR TECHNICAL

Crystal clear

DANIEL VASCONCELLOS

Years ago, I was on a team working for All American Racers in Santa Ana, CA. During a test session, the sound of our team's newly designed Indy car screaming by at 180 mph made it difficult for us to identify the bothersome interference problems in our 460-MHz FM car-to-pit radio-communication system. We moved our equipment to a picnic table in the infield where there was less ambient noise and settled down to figure out why it was so hard for the driver and the race engineer to communicate. The racing season was coming up, and we needed a reliable radio for race-strategy communications.

The team was made up of world-class mechanical geniuses, but they were afraid of "wires." In the good old days, the only cabling on an Indy car was a single 12-gauge wire running from the magneto to the kill switch on the dashboard. Our more modern contender had miles of daunting wiring for the engine-control unit, the data-acquisition harness, telemetry, and the voice-communication system.

One of my first assignments was helping to identify and eliminate the radio interference. The mechanics could describe whatever it was as simply "noise." My supervisor felt that we should and could be a bit more specific.

Research at the shop had suggested a number of possibilities. A 50-kV ignition system is always a suspect. I tried to apply my experience with high-end stereos and remembered the way that metal body panels of luxury cars connect to each other with stout ground straps and that the front wheels have copper electrical-contact springs under the wheel-bearing caps to prevent interference. A passage in our ham-radio bible intrigued us; it spoke briefly of putting "tire powder" inside automobile tires to stop tire-generated static.

We put on our own headsets and listened to the driver and the engineer. I recognized minor amounts of electrical static, FM interference, and wind noise, but the major problem sounded to me like plain old acoustic noise from the engine's exhaust. The driver's helmet had a good noise-canceling military pilot's microphone, and he kept the mike as close as possible to his lips, but the noise level remained unacceptable.

After some brainstorming, we disconnected the driver's microphone and instructed him to press the push-to-talk button on his steering wheel while he was out doing laps. The noise remained. The radio was soft-mounted in the chassis like the rest of the electronics to prevent damage from the tremendous vibration caused by the hard-mounted engine, so we made sure the foam hadn't fallen out. We double-checked that the normally handheld radio's original microphone was still unplugged internally. Somehow, magically, the deaf radio was determined to listen to the engine's 850-horsepower holler as much as the driver's one-man-power mouth. Beating a spare radio with a hammer on our table produced similar results. Disassembling the radio and hammering the circuit board suggested a problem with the PLL (phase-locked-loop) circuitry.

More research revealed that most PLL radios are inherently microphonic—normally, to a negligible extent. It looked as though we shouldn't have placed our major-brand radio 2½ feet away from an unmuffled, 12,000-rpm, turbocharged V8 engine at full song! We had some older crystal radios still in a cabinet, and we tried one at the next test expedition before modifying a PLL unit. Voilà! My supervisor felt we had ourselves a "speed secret" and instructed us not to tell any other team. But we're still wondering what the story is on the mysterious tire powder. EDN

Roy Gardner has tamed electrons for several major electronics firms and Indy car teams.