

Topic 10:
Design, implementation and programming of the
Electret Microphone Interface
for the Slow Control System MPD-NICA,
on the NImyRIO and LabView platforms.¹

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10 Electret Microphone

A microphone serves as an acoustic sensor to record audio signals and to monitor acoustic level. Electret microphones provide good performance at low cost. The Chenyun CY-502 electret microphone pictured in Figure 10.1 is designed to connect directly to laptop computer soundcard inputs, and can also connect directly to the NImyRIO AUDIO IN jack.



*Figure 10-1; NImyRIO StarterKit
Electret Microphone.*

10.1.1 Learning Objectives:

After completing the activities in this chapter you will be able to:

- [a] Discuss the electret microphone operating principle based on parallel-plate capacitance,
- [b] Apply the “phantom power” provided by the NImyRIO AUDIO IN jack to power the electret microphone JFET impedance-level shifter,

¹ Developed on the basis of educational materials: National Instruments, IBM, Reichle & De-Massari, Microsoft, Warsaw University of Technology, Joint Nuclear Institute Research

- [c] Increase the microphone gain with a simple inline preamplifier circuit powered by the NImyRIO AUDIO IN jack.

10.2 Component Demonstration

Follow these steps to demonstrate correct operation of the microphone.

10.2.1 Select these parts from the NI myRIO Starter Kit:

- [a] Chenyun CY-502 computer microphone,

http://www.chenyun.cc/product_en.asp?ProductID=859

10.2.2 Build the interface circuit:

This microphone integrates a standard 3,5 mm audio jack that can plug directly into the NImyRIO AUDIO IN jack, consequently no special circuit is required. Refer to the diagram in Figure 10.2.

10.2.3 Run the demonstration VI:

- [a] Download

<http://www.ni.com/academic/myrio/project-guide-vis.zip>

- [b] if you have not done so previously and unpack the contents to a convenient location,
- [c] Open the project Electret Microphone demo.lvproj contained in the subfolder Electret Microphone demo,
- [d] Expand the hierarchy button (a plus sign) for the myRIO item and then open Main.vi by double-clicking,
- [e] Confirm that NImyRIO is connected to your computer,
- [f] Run the VI either by clicking the Run button on the toolbar or by pressing Ctrl+R.

Expect to see a “Deployment Process” window showing how the project compiles and deploys (downloads) to NImyRIO before the VI starts running.

NOTE: You may wish to select the “Close on successful completion” option to make the VI start automatically.



Figure 10-2; Demonstration circuit for Electret Microphone connected directly to AUDIO IN.

10.2.4 Expected results:

The demo VI displays the audio signal detected by the microphone as an oscilloscope display.

Try whistling, speaking, singing, or any other sound, and you should see the corresponding waveform. You will need to position the microphone quite close to the sound source.

Click the Stop button or press the escape key to stop the VI and to reset NImyRIO.

10.2.5 Troubleshooting tips:

Not seeing the expected results? Confirm the following points:

- [a] Glowing power indicator LED on NImyRIO,
- [b] Black Run button on the toolbar signifying that the VI is in run mode,
- [c] Microphone plugged into the AUDIO IN jack instead of the adjacent AUDIO OUT jack.

10.3 Interface Theory

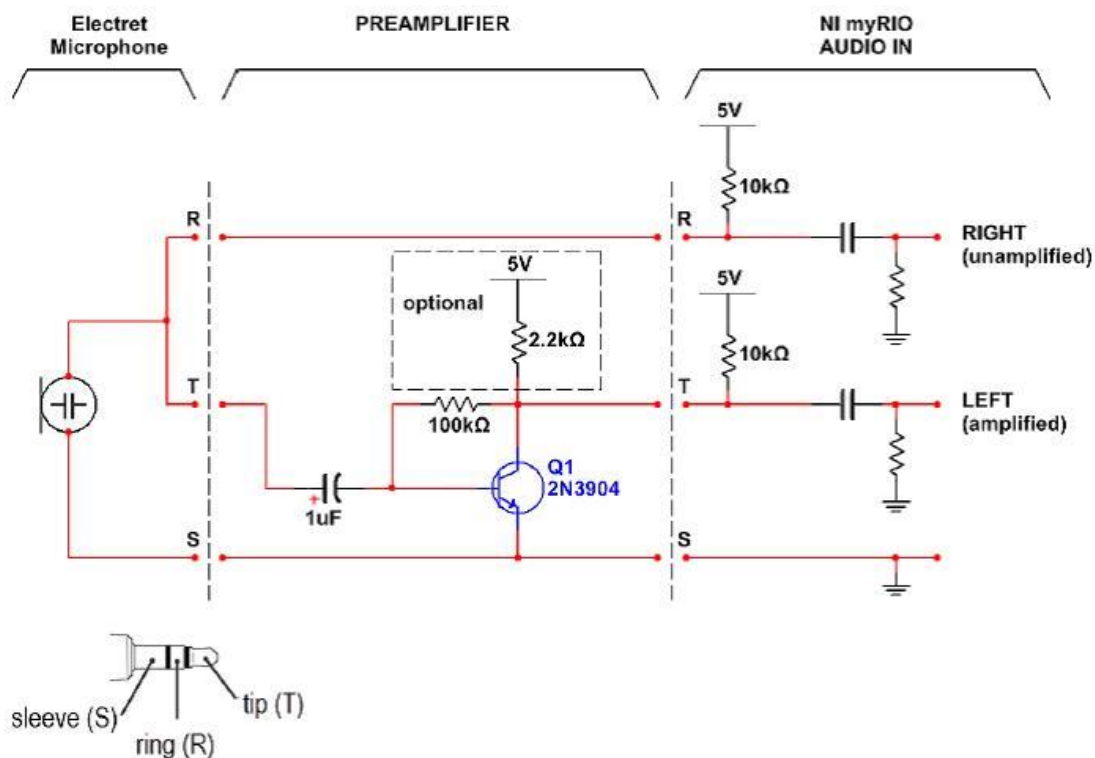


Figure 10-3; Preamplifier circuit to connect between the Electret Microphone and AUDIO IN.

The NImyRIO AUDIO IN jack provides power to both the Electret Microphone and the preamplifier circuit.

The optional 2.2 kΩ resistor connected to the NImyRIO five-volt supply doubles the signal headroom to ± 2 volts.

10.3.1 Interface circuit:

The Chenyun CY-502 Electret Microphone produces a monophonic (single channel) audio signal of fractions of a volt up to more than a volt depending on the proximity and intensity of the sound source.

Study the video *Electret Microphone Principles and Preamplifier Circuit* (8:48)

<https://www.youtube.com/watch?v=izJni0PM0bI&feature=youtu.be>

to learn about the Electret Microphone principle of operation and the NImyRIO equivalent circuit for the AUDIO IN that provides power to the Electret Microphone as well as AC signal

coupling; the video also describes a simple three-component audio preamplifier circuit (Figure 10.3) that applies a gain factor of over 100 x to greatly improve the sensitivity of the microphone.

10.4 Basic Modifications

Study the video *Electret Mic Demo Walk-Through* (2:52)

<https://www.youtube.com/watch?v=kZoFwQRYz98>

to learn the design principles of Electret Microphone demo, and then try making these modifications to the block diagram of Main.vi:

- [a] Add a real-time amplitude spectrum display; use the point-by-point version of the built-in Amplitude and Phase Spectrum VI located on the Signal Processing | Point by Point | Spectral subpalette.
- [b] Add a VU (volume) meter that displays signal intensity; use the AC output of the built-in AC & DC Estimator PtByPt VI located on the Signal Processing | Point by Point | Sig Operation subpalette.
- [c] Try building the simple three-component audio preamplifier circuit of Figure 10.3, if you find that the electret microphone provides insufficient sensitivity for your application. You may wish to build this circuit on a small “perf board” (perforated plastic board with holes drilled on 0,1” centres) with a jack on one side for the CY-502 and a plug on the other side; use a jack on the output side to use the audio cable included with your NImyRIO. The optional 2.2 k Ω resistor connected to the NImyRIO five-volt supply doubles the signal headroom to ± 2 volts and maximizes the signal available to the AUDIO IN analog-to-digital converter.

10.5 Integrated Project Ideas

Now that you know how to use the Electret Microphone consider integrating it with other devices to create a complete system, for example:

- [a] Handheld Meter (Topic 39)
- [b] Wireless Sensor (Topic 40)
- [c] Data Logger (Topic 41)
- [d] Steer By Wire (Topic 43)
- [e] Guitar Tuner (Topic 54)

10.6 For More Information

- [a] Computer Microphones by Hobby-Hour.com ~ Describes the tip-ring-sleeve jack wiring and power supply connections for electret microphones and computer soundcards:

http://www.hobby-hour.com/electronics/computer_microphone.php

- [b] Electret Microphones by Open Music Labs ~ An excellent detailed teardown and explanation of Electret Microphone operating principles:

<http://www.openmusiclabs.com/learning/sensors/electret-microphones>

- [c] Preamp to Electret Mic by Instructables ~ A simple and effective preamplifier to raise the electret mic voltage level to line level:

<http://www.instructables.com/id/Pre-amp-to-electret-mic>

Bibliography:

- [a] www.jinr.ru
- [b] www.ni.com
- [c] www.nica.if.pw.edu.pl
- [d] The Multi-Purpose Detector – MPD to Study Heavy Ion Collisions at NICA; (CDR Conceptual Design Report) Version 1.4; Project leaders: A. N. Sissakian, A. S. Sorin, V. D. Kekelidze.
- [e] http://www.chenyun.cc/product_en.asp?ProductID=859
- [f] <http://www.ni.com/academic/myrio/project-guide-vis.zip>
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- [i] http://www.hobby-hour.com/electronics/computer_microphone.php
- [j] <http://www.openmusiclabs.com/learning/sensors/electret-microphones>
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