**# Sensors Project – Experiment Two: Cables & Data Transmission Experiment - Brief**

# Introduction

The objective of this project is to create an experiment that investigates various measurements on different cable types, aiming to determine how the construction and in-circuit implementation of these cables can affect the measurable signal to noise ratio.

# Equipment

The experiment will use the following equipment:

* PicoScope 2000
* Suitable range of different cables
* A source of wide band E.M.F noise
* Analog switches/gates/multiplexers

# Experiment Concept

The idea behind this experiment involves introducing noise to different cable constructions and measuring the resulting signal's signal to noise ratio (SNR). Since several aspects of this process are unproven, the development phase will need to meticulously explore various details to establish the experiment's viability. Although this investigation is open-ended, the following sections lists several areas that are likely worth exploring and collecting experimental data on.

# Potential Experiments

This section records potential ideas that we consider interesting for developing experiments; utilizing this equipment for remote laboratories. This should be considered a general guide, if investigation leads to alternatives, they should also be explored and discussed.

## Shielded Cable Implementation

* Compare SNR between:
  + Single core cable
  + Screened/shielded cable – ungrounded
  + Screened/Shielded cable – grounded at a single end
  + Screened/Shielded cable – grounded at each end

## Twisted vs non twisted pairs

* Compare data transmission fidelity over twisted and non-twisted pairs
* Investigate EMF transmitted from twisted/non twisted pairs.

## CAT5 cable

## Comparing quality of cables

* RF / Audio spec cable comparison. (may be hampered by low bandwidth of PicoScope)

## Cable isolated from ground planes vs run along ground planes

* Prove the audiophiles correct, does lifting a cable off the ground increase SNR?

# Potential Areas of Investigation

This section records unknown aspects that may affect the development and implementation of the above experiments. These unknowns should be explored before continuing further development towards the remote labs experiment in order to mitigate risk and guide the development process.

## Ease of using PicoScope for SNR measurements

* Take a range of measurements using a PicoScope to deduce the usefulness of this equipment for this purpose.

## Analog Switching for grounding

* For experiments that require grounded and ungrounded connections
* Is this possible to achieve with analog mux ICs, MOSFETS or BJTs?
* Is an open collector the same as a floating wire?
* Alternative methods for switching PicoScope probes to different parts of the circuit
* RF switches – see VNA experiment

## Reliable EMF noise source

* What is a suitable controllable source of EMF noise?
* Is background noise enough for experimental outcomes?
* Does this change once experiment is inside metal enclosure?

# Constraints

* All PicoScope signals must be constrained to ±5 V
* Voltage supplied to the circuit will be ±5 V
* No more than 100mA Current draw max from either +5 V or -5V bus.
* Additional High Current 5v supply will be provided for high current loads. (i.e. heating elements, bulbs, fans). No more than 1.5A should be drawn from this supply.

# Deliverables

This project will be broken down into the following deliverables with a timeframe to be arranged between intern and supervisors.

## Conduct investigation into experimental unknowns

* Expand on list of unknown quantities in sensors 2 experiment concept
* Write a short report detailing investigation into unknown quantities.
  + Report should detail facts gathered, workarounds to any potential issues found, and suggestions for experimental development.

## Design Experiment

* Take into account lessons learned in previous exercise to develop an experimental concept to develop into a prototype.
* Develop schematic and test procedure that takes into account the constraints of the equipment and remote labs environment.

## Prototype Experimental Setup

* Breadboarded setup of the above schematic to show reliability of measurements, and repeatability of the experimental setup.
* Define procedure for physical assembly, mounting of sensors to test articles etc.
* Work with STO to help define PCB layout.

## Mathematical Model

* Stretch goal
* Develop a mathematical model to accompany the experimental setup.
* Show how typical results differ from idealised model and explain rational behind the differences.