



## Lab Scopes: Intro and Advanced

Finally! A book about lab scope basics with a touch on advanced testing!

### Overview

Lab Scopes—just mention the words, and some guys shudder with fear and confusion. Oh, they may not show it, but deep down inside, they get nervous. How do they work, how do you get the pattern on the screen, and what does the pattern mean? How do you know if the signal is good or bad? That's what this book is about.

The purpose of this book is to make it simple. You'll learn what you need to know to start successfully using a lab scope including:

- How does a lab scope work? (in very simple terms)
- When you look at a pattern on the scope, what are you seeing, and how do you know if it is bad?
- How do you get a pattern on the scope, how do you do the adjustments to make the pattern look right?
- What do you do when you can't get a pattern on the screen at all? (A lot of guys have this problem, but don't admit it to their friends...)
- What are some of the different things you can do and see with the lab scope? (Most technicians don't know how much diagnosis you can do with an inexpensive scope, and a few attachments.)
- What are the different types of scopes? And what are they good for? Do you have to spend a lot of money for a really expensive one? And where would you get one?
- Where and how do you hook up the scope to the circuit? Does it make much difference?

This book consists of 62-pages and is written in a down-to-earth manner so you can quickly learn what you need to know.

### About the author:

Steve McAfee is a respected automotive instructor at Skyline College in San Bruno California. He has over 35 years of experience in the automotive field, writes questions for the Smog Check Technician's License exam, and is a California certified clean air car instructor.

### Table of Contents

## **Introduction**

### **Chapter 1 Lab Scopes – How do they work?**

Compared to a Scan Tool  
Compared to a Voltmeter  
What a Lab Scope Shows  
Analog or Digital  
Analog Lab Scopes  
Digital Lab Scopes  
Downside of Digital  
Advantages of Digital  
Introduction to a Basic Model  
Divisions or Graticules  
Voltage  
Time  
Zero Point  
Channels

### **Chapter 2 Basic Electricity, Circuits and Digital Signals**

What is Electricity?  
Definitions  
Voltage  
Amperage  
Resistance  
Watts  
Types of Circuits  
Series Circuit  
Parallel Circuit  
Digital Signals  
Hertz or HZ  
Duty Cycle  
Pulse Width  
Number Symbols  
Milli or m  
Kilo or K  
Micro or  $\mu$   
Mega or M

### **Chapter 3 Pattern Recognition**

Magnetic Pickup RPM Sensor  
Hall Effect RPM Sensor  
Optical RPM Sensor  
Throttle Position Sensor  
Fuel Injector  
Duty Cycle  
Ignition Primary  
Alternator Ripple

### **Chapter 4 Getting a Pattern on the Scope**

What if nothing happens when you turn it on?  
Where to connect the test leads?  
The Black Test Lead  
The Red Test Lead  
Warning  
To look at a Computer Input  
About Shielded Wires and Electrical Noise  
To look at a Computer Output  
How to Connect to the Wire  
How to Back Probe a Wire  
To Puncture or not to Puncture the Wire  
Why Do It? (Puncture Wires)  
How to Puncture the Wire  
What to Adjust? Or Why Doesn't My Pattern Look Right?  
Voltage Adjustment  
Time Settings  
Ground Positioning  
10:1 Probes  
Sampling Rate  
What to Do

### **Chapter 5 Trigger**

Positive and Negative Slope  
To Adjust the Trigger  
Tricky Stuff About Trigger  
What Do You Mean Trigger Mode?  
Trigger Mode and Intermittent Signals  
Uses for Trigger Mode

### **Chapter 6 Relative Compression**

Counter Electro-motive Force  
To Measure Starter Current  
High Amp Probe (or Current Clamp)  
Set Up Your Scope  
How Do You Know Which Cylinder is Low?  
Relative Compression Test

### **Chapter 7 Fuel Pumps**

Low Amp Probes  
Where to Attach the Current Probe  
About Fuel Pumps  
Fuel Pump Commutator Segments  
Fuel Pump Brushes  
Another Fuel Pump Design  
Good Fuel Pump Pattern  
Bad Fuel Pump Pattern  
After Replacing the Pump

### **Chapter 8 Primary Ignition**

How to Generate Spark  
Capacitive Discharge System  
Primary Wiring  
10:1 Filter  
When You Hook Up Your Scope  
What The Scope Pattern Means  
Dwell or Saturation  
Spark Duration  
Using Spark Duration for Diagnosis  
High Resistance  
Low Resistance  
RPM Probes  
RPM Trigger  
Primary Ignition Pattern  
High Resistance Problem

### **Chapter 9 Primary Ignition Amperage or Current Ramping**

Counter Electromotive Force (CEMF)  
Primary Ignition Volts  
Primary Amperage  
Computer Controlled Dwell  
Low Current Probe  
What To Look For  
Normal Good Current Ramp  
Possible Problems to Diagnose

### **Chapter 10 Secondary Ignition**

High Voltage  
Basic Secondary Ignition Pattern  
Firing KV  
String Theory  
Open Spark Plug Wire  
High KV  
High Resistance Problems  
Low KV  
Low Resistance Problems  
String Theory Example  
Low Resistance  
10,000:1 Probe  
Secondary Ignition Readings  
Secondary Hookup  
Voltage Between Probe and Ground  
Using an Adapter  
Using Adapters to Pick Up Signals  
Foil Tape  
"Right Side Up" Patterns  
Pattern Points Down  
Ignition Sparks Go Down  
DIS Systems  
Parade Patterns  
Normal Engine  
Low Resistance Problem  
Parade Pattern of 4 Cylinder Engine