LOGIC PROBE

User Manual & Technical Reference

Model: LP-3355

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DOCUMENT INFORMATION

Field	Information
Product Name	Auto-Adaptive Logic Probe
Model Number	LP-3355
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Supersedes	None (Initial Release)
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1. SAFETY INFORMATION

1.1 IMPORTANT SAFETY INSTRUCTIONS

⚠ **WARNING:** Read all safety instructions before operation. Failure to follow these instructions may result in equipment damage or personal injury.

1.1.1 Electrical Safety

- **Maximum Input Voltage:** 5.5V DC
- **Do not exceed** rated input voltage
- **Ensure proper grounding** of test circuits
- **Disconnect power** before making connections
- **Use only** in dry conditions

1.1.2 Operating Environment

- **Temperature Range:** 0°C to +50°C (32°F to 122°F)
- **Humidity:** 85% RH maximum, non-condensing
- **Altitude:** Up to 2000m above sea level
- **Pollution Degree:** 2 (as per IEC 61010-1)

1.1.3 Personnel Safety

- **Qualified Personnel Only:** Operation requires basic knowledge of digital electronics
- **ESD Precautions:** Use anti-static procedures when handling
- **Do not operate** with damaged probe tip or leads

1.2 SAFETY SYMBOLS

Symbol	Meaning
⚠	Warning - Risk of injury or equipment damage
⚡	Electrical hazard
🛡	Safety instruction
ℹ	Important information

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2. GENERAL INFORMATION

2.1 PRODUCT OVERVIEW

The LP-3355 Logic Probe is a professional-grade digital signal detector designed for troubleshooting and analysis of digital circuits. The instrument automatically adapts to different logic families (3.3V and 5.0V) without manual configuration, providing visual and audible indication of digital signal states.

2.2 KEY FEATURES

2.2.1 Auto-Adaptive Operation

- **Automatic Logic Family Detection:** 3.3V and 5.0V systems
- **No Manual Switching Required:** Self-configuring thresholds
- **Universal Compatibility:** TTL, CMOS, LVCMOS logic families

2.2.2 Detection Capabilities

- **Logic HIGH Detection:** Visual indication via RED LED
- **Logic LOW Detection:** Visual indication via GREEN LED
- **Pulse Activity Detection:** Visual (BLUE LED) and audible (buzzer) indication
- **High Input Impedance:** >1MΩ input impedance prevents circuit loading

2.2.3 Construction Features

- **Minimal Component Design:** 13-component implementation
- **Self-Powered Operation:** Powered directly from target circuit
- **Compact Form Factor:** 35mm × 120mm PCB
- **Educational Design:** Clear component identification and signal flow

2.3 TYPICAL APPLICATIONS

2.3.1 Digital Circuit Analysis

- Logic state verification at IC pins
- Bus activity monitoring
- Clock signal detection

- Power-on reset sequence analysis

2.3.2 Educational Applications

- Digital electronics laboratory exercises
- Logic family comparison studies
- Signal integrity demonstrations
- Troubleshooting methodology training

2.3.3 Professional Applications

- Field service diagnostics
- Production line testing
- Design validation
- Maintenance troubleshooting

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3. TECHNICAL SPECIFICATIONS

3.1 ELECTRICAL CHARACTERISTICS

Parameter	Min	Typ	Max	Unit	Conditions
Supply Voltage	3.3	-	5.5	V	Operating range
Supply Current	-	6	8	mA	All LEDs off
Input Voltage Range	0	-	VCC	V	Safe operating range
Input Impedance	1	-	-	MΩ	DC measurement
Response Time	-	50	100	ns	10% to 90% rise time

3.2 LOGIC THRESHOLDS

3.2.1 Adaptive Thresholds

Logic Family	VCC	V_IL (Max)	V_IH (Min)	Hysteresis
3.3V LVCMOS	3.3V	1.0V	2.3V	50mV
5.0V TTL/CMOS	5.0V	1.5V	3.5V	75mV

Threshold Calculations:

- V_IL = 0.30 × VCC ± 5%
- V_IH = 0.70 × VCC ± 5%

3.3 PERFORMANCE SPECIFICATIONS

Parameter	Specification	Notes
Minimum Pulse Width	1µs	For reliable pulse detection
Maximum Frequency	10MHz	Clock/pulse signals
Input Capacitance	<10pF	Minimal circuit loading
Propagation Delay	<100ns	Input to LED indication
LED Brightness	2-5mcd	Optimized for lab visibility
Buzzer Frequency	2.5kHz	Pulse activity indication

3.4 ENVIRONMENTAL SPECIFICATIONS

Parameter	Specification
Operating Temperature	0°C to +50°C
Storage Temperature	-20°C to +70°C
Humidity	85% RH max, non-condensing

Parameter	Specification
Altitude	2000m maximum
Shock	50g, 11ms half-sine
Vibration	2g, 10-500Hz

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4. OPERATING INSTRUCTIONS

4.1 BASIC OPERATION

4.1.1 Connection Procedure

1. **Power Connection:**
   - Connect RED lead to target circuit VCC (+3.3V or +5.0V)
   - Connect BLACK lead to target circuit GND (0V)
   - Observe power indicator behavior
2. **Signal Probing:**
   - Touch probe tip to digital signal under test
   - Observe LED indication pattern
   - Listen for audible pulse indication

4.1.2 LED Indication Patterns

LED State	Signal Condition	Voltage Range
🟢 **GREEN**	Logic LOW	0V to V_IL
🔴 **RED**	Logic HIGH	V_IH to VCC
🔵 **BLUE + Buzzer**	Pulse/Clock Activity	Transitions detected
No LED	Invalid/Undefined	V_IL to V_IH

4.2 ADVANCED OPERATIONS

4.2.1 Logic Family Identification

The instrument automatically identifies logic families based on supply voltage:

3.3V Systems (LVCMOS):

- Thresholds: LOW <1.0V, HIGH >2.3V
- Common in: Modern microcontrollers, FPGAs, ARM processors

5.0V Systems (TTL/CMOS):

- Thresholds: LOW <1.5V, HIGH >3.5V
- Common in: Legacy systems, Arduino, discrete logic ICs

4.2.2 Pulse Detection Analysis

- **Continuous Pulses:** Blue LED flashes with buzzer tone
- **Single Pulses:** Brief blue flash (1µs minimum detection)
- **Clock Signals:** Continuous blue indication during activity
- **Glitches:** May trigger pulse detection if >1µs duration

4.3 MEASUREMENT TECHNIQUES

4.3.1 Static Logic Level Testing

1. Connect power leads to target circuit
2. Touch probe tip to test point
3. Verify steady-state LED indication
4. Compare with expected logic level

4.3.2 Dynamic Signal Analysis

1. Monitor signal transitions in real-time
2. Use pulse indication to detect activity
3. Verify clock signal presence
4. Check for intermittent signal conditions

4.3.3 Circuit Troubleshooting Methodology

1. **Power Supply Verification:** Confirm VCC and GND connections
2. **Input Signal Validation:** Verify logic levels at circuit inputs
3. **Propagation Tracking:** Follow signal path through logic stages
4. **Output Verification:** Confirm expected outputs from each stage

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5. INSTALLATION & SETUP

5.1 UNPACKING AND INSPECTION

5.1.1 Package Contents

- 1× Logic Probe (Model LP-3355)
- 1× User Manual
- 1× Test lead set (Red/Black power leads)
- 1× Probe tip
- 1× Quick Reference Card

5.1.2 Initial Inspection

1. **Visual Inspection:** Check for physical damage
2. **Component Verification:** Ensure all LEDs and components are properly mounted
3. **Connection Integrity:** Verify probe tip and lead connections
4. **Documentation:** Confirm all materials are included

5.2 INITIAL SETUP

5.2.1 Workspace Preparation

- **ESD Protection:** Use anti-static mat and wrist strap
- **Adequate Lighting:** Ensure clear visibility of LED indicators
- **Ventilation:** Maintain appropriate room temperature
- **Tool Access:** Keep multimeter available for verification

5.2.2 First Power-On Test

1. **Connect to Known Good 5V Supply:**
   - Red lead to +5V
   - Black lead to GND
   - Verify no LED indication (no signal on probe tip)

2. **Logic Level Verification:**
    - Touch probe tip to +5V: RED LED should illuminate
    - Touch probe tip to GND: GREEN LED should illuminate
    - Apply 1kHz square wave: BLUE LED and buzzer should activate

5.3 CALIBRATION VERIFICATION

5.3.1 Threshold Accuracy Check

Using precision voltage source, verify threshold voltages:

For 5.0V Supply:

- Apply 1.4V: Should show GREEN LED (below V_IL)
- Apply 1.6V: Should show no LED (invalid region)
- Apply 3.4V: Should show no LED (invalid region)
- Apply 3.6V: Should show RED LED (above V_IH)

For 3.3V Supply:

- Apply 0.9V: Should show GREEN LED
- Apply 1.1V: Should show no LED
- Apply 2.2V: Should show no LED
- Apply 2.4V: Should show RED LED

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6. PERFORMANCE VERIFICATION

6.1 FUNCTIONAL TESTING

6.1.1 Power Supply Tests

Test	Procedure	Expected Result	Pass/Fail
3.3V Operation	Connect to 3.3V supply	All functions operational	☐
5.0V Operation	Connect to 5.0V supply	All functions operational	☐
Current Consumption	Measure supply current	<10mA	☐
Voltage Range	Test 3.3V to 5.5V range	Proper operation	☐

6.1.2 Logic Detection Tests

Test	Input Voltage	Expected LED	Pass/Fail
LOW Detection	0V	GREEN	☐
HIGH Detection	VCC	RED	☐
Invalid Region	0.5×VCC	No LED	☐
Threshold Accuracy	V_IL ± 50mV	Transition	☐

6.1.3 Pulse Detection Tests

Test	Signal Type	Expected Response	Pass/Fail
1kHz Square Wave	50% duty cycle	Blue LED + buzzer	☐
10MHz Clock	High frequency	Blue LED + buzzer	☐
Single Pulse	10µs width	Brief blue flash	☐
Glitch Detection	2µs spike	Pulse indication	☐

6.2 PERFORMANCE VALIDATION

6.2.1 Input Impedance Measurement

1. **Setup:** Connect 1MΩ resistor in series with voltage source
2. **Procedure:** Apply known voltage through resistor to probe
3. **Measurement:** Verify <1% voltage drop across resistor
4. **Specification:** Confirms >1MΩ input impedance

6.2.2 Response Time Measurement

1. **Equipment Required:** Fast oscilloscope, signal generator
2. **Setup:** Monitor LED output with photodiode and scope
3. **Procedure:** Apply fast logic transitions to input
4. **Measurement:** Verify propagation delay <100ns

6.3 ENVIRONMENTAL TESTING

6.3.1 Temperature Performance

- **Cold Test:** Operation at 0°C for 30 minutes
- **Hot Test:** Operation at +50°C for 30 minutes
- **Thermal Cycling:** 10 cycles between temperature extremes
- **Verification:** Functional testing at each temperature

6.3.2 Humidity Testing

- **High Humidity:** 85% RH at 40°C for 48 hours
- **Condensation:** Verify no condensation on PCB

- **Recovery:** Return to normal conditions and test function

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7. TROUBLESHOOTING

7.1 COMMON PROBLEMS AND SOLUTIONS

7.1.1 Power-Related Issues

Problem: No LED indication when probe tip touched to known signals

Possible Cause	Solution	Verification
No power connection	Check red/black lead connections	Measure VCC and GND
Incorrect polarity	Reverse power lead connections	Verify +V on red lead
Supply voltage out of range	Use 3.3V to 5.5V supply only	Measure supply voltage
Blown fuse protection	Check internal protection	Contact service

Problem: High supply current consumption (>15mA)

Possible Cause	Solution	Verification
Multiple LEDs on	Normal with signal activity	Monitor in static condition
Shorted component	Visual inspection of PCB	Check for damaged components
Overload condition	Remove probe from circuit	Measure current without load

7.1.2 Logic Detection Issues

Problem: Incorrect logic level indication

Possible Cause	Solution	Verification
Wrong supply voltage	Verify target circuit VCC	Measure at circuit VCC pin
Threshold drift	Calibration verification required	Test with precision voltage
Input loading	Check for excessive capacitance	Use scope to verify signal
Noise interference	Add ground connection	Improve grounding

Problem: No pulse detection despite clock activity

Possible Cause	Solution	Verification
Pulse width too narrow	Minimum 1µs required	Verify pulse width with scope
Amplitude insufficient	Check signal swing	Verify signal meets logic levels
High frequency limitation	Maximum 10MHz	Reduce frequency for test
Defective pulse circuit	Contact service	Test with known good signal

7.1.3 Mechanical Issues

Problem: Intermittent probe tip connection

Possible Cause	Solution	Verification
Loose probe tip	Tighten connection	Check mechanical integrity
Worn probe tip	Replace probe tip	Visual inspection
Broken internal wire	Contact service	Continuity test

7.2 DIAGNOSTIC PROCEDURES

7.2.1 Self-Test Procedure

1. **Power Connection Test:**

- Connect to known good 5V supply
- Verify current consumption <10mA

2. **Logic Level Test:**
   - Touch probe to +5V: RED LED should illuminate
   - Touch probe to GND: GREEN LED should illuminate
   - Remove probe: No LEDs should be on

3. **Pulse Test:**
   - Connect to 1kHz signal generator
   - Apply 0-5V square wave to probe
   - Verify BLUE LED and buzzer activation

7.2.2 Advanced Diagnostics

1. **Threshold Measurement:**
   - Use precision voltage source
   - Sweep voltage from 0V to VCC
   - Record exact threshold voltages
   - Compare with specifications

2. **Response Time Test:**
   - Apply fast edge to input
   - Monitor LED response with photodiode
   - Measure propagation delay

7.3 ERROR CODES AND INDICATORS

Indication	Meaning	Action Required
All LEDs flash rapidly	Self-test mode	Normal during power-on
All LEDs solid on	Internal fault	Contact service
Dim LED indication	Low supply voltage	Check power connections
No LEDs ever	Power fault	Verify supply voltage

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8. MAINTENANCE

8.1 ROUTINE MAINTENANCE

8.1.1 Daily Inspection (if used regularly)

- **Visual Check:** Inspect probe tip and leads for damage
- **Connection Verify:** Ensure secure connections
- **LED Function:** Quick functional test with known signals
- **Cleanliness:** Keep probe tip clean and free of flux residue

8.1.2 Weekly Maintenance

- **Calibration Check:** Verify threshold accuracy
- **Connection Cleaning:** Clean all connections with isopropyl alcohol
- **Storage:** Store in dry, clean environment when not in use

8.1.3 Monthly Maintenance

- **Performance Verification:** Complete functional test procedure

- **Documentation Update:** Record any issues or changes
- **Environmental Check:** Verify operating conditions are maintained

8.2 CLEANING PROCEDURES

8.2.1 Probe Tip Cleaning

1. **Disconnect power** before cleaning
2. **Use isopropyl alcohol (99%)** on lint-free cloth
3. **Gently clean** probe tip and connections
4. **Allow complete drying** before use
5. **Avoid abrasive materials** that could damage contacts

8.2.2 PCB Cleaning

1. **Power off and disconnect** all connections
2. **Use electronics cleaner** or isopropyl alcohol
3. **Apply with soft brush** to remove flux residue
4. **Dry thoroughly** before reconnecting
5. **Inspect for corrosion** or component damage

8.3 CALIBRATION

8.3.1 Calibration Schedule

- **Initial Calibration:** Factory calibrated, no adjustment required
- **Verification Schedule:** Every 6 months or 1000 hours of use
- **Recalibration Triggers:** If verification fails specifications
- **Environmental:** After exposure to extreme conditions

8.3.2 Calibration Procedure

Note: This instrument is designed for no-adjustment operation. If calibration verification fails, contact service department.

1. **Equipment Required:**
   - Precision voltage source (±0.1% accuracy)
   - Digital multimeter
   - Function generator
2. **Verification Points:**
   - Supply current at 3.3V and 5.0V
   - Threshold voltages at both supply levels
   - Pulse detection sensitivity
   - Response time measurement

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9. WARRANTY & SERVICE

9.1 WARRANTY INFORMATION

9.1.1 Standard Warranty

- **Duration:** 24 months from date of purchase
- **Coverage:** Defects in materials and workmanship
- **Exclusions:** Damage from misuse, accident, or unauthorized repair
- **Geographic:** Valid worldwide with authorized distributors

9.1.2 Warranty Claims

To make a warranty claim:

1. **Contact:** Technical support with model and serial number
2. **Description:** Provide detailed problem description
3. **Authorization:** Obtain return authorization number
4. **Shipping:** Package securely and ship to authorized service center

9.2 SERVICE OPTIONS

9.2.1 Factory Service

- **Calibration Services:** NIST-traceable calibration available
- **Repair Services:** Factory-trained technicians
- **Upgrade Services:** Hardware and firmware updates
- **Replacement Parts:** Original manufacturer parts only

9.2.2 Field Service

- **On-site Calibration:** Available for large installations
- **Training Services:** User training and application support
- **Preventive Maintenance:** Scheduled maintenance programs
- **Technical Support:** Phone and email support available

9.3 CONTACT INFORMATION

9.3.1 Technical Support

- **Phone:** +1-800-LOGIC-01 (US/Canada)
- **Email:** support@logicprobe.com

- **Hours:** Monday-Friday, 8 AM - 6 PM EST
- **Website:** www.logicprobe.com/support

9.3.2 Service Centers

North America:

- Address: 123 Electronics Drive, Tech City, TC 12345
- Phone: +1-800-SERVICE
- Email: service-na@logicprobe.com

Europe:

- Address: 456 Digital Street, Logic Town, LT1 2AB, UK
- Phone: +44-20-1234-5678
- Email: service-eu@logicprobe.com

Asia Pacific:

- Address: 789 Circuit Avenue, Silicon City, SC 67890, Singapore
- Phone: +65-6123-4567
- Email: service-ap@logicprobe.com

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10. REGULATORY COMPLIANCE

10.1 SAFETY STANDARDS

10.1.1 International Standards

- **IEC 61010-1:2010** - Safety requirements for electrical equipment

- **IEC 61010-2-030** - Particular requirements for testing and measuring circuits
- **EN 61326-1** - EMC requirements for electrical equipment
- **UL 61010-1** - US safety requirements

10.1.2 Environmental Compliance

- **RoHS Directive 2011/65/EU** - Restriction of hazardous substances
- **WEEE Directive 2012/19/EU** - Waste electrical equipment
- **REACH Regulation (EC) 1907/2006** - Chemical substances registration

10.2 EMC COMPLIANCE

10.2.1 Emission Standards

- **CISPR 11 Group 1 Class A** - Electromagnetic emissions
- **EN 55011:2016** - Industrial scientific equipment
- **FCC Part 15 Class A** - Radio frequency emissions

10.2.2 Immunity Standards

- **EN 61000-4-2** - Electrostatic discharge immunity
- **EN 61000-4-3** - Radiated electromagnetic field immunity
- **EN 61000-4-4** - Electrical fast transient immunity
- **EN 61000-4-6** - Conducted RF immunity

10.3 DECLARATION OF CONFORMITY

This product conforms to the following directives and standards:

- **EMC Directive 2014/30/EU**

- **Low Voltage Directive 2014/35/EU**
- **RoHS Directive 2011/65/EU**

Manufacturer: Logic Probe Technologies, Inc. **Authorized Representative:** [Company Name and Address] **Declaration Date:** September 01, 2025

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11. APPENDICES

APPENDIX A: TECHNICAL DRAWINGS

A.1 Mechanical Dimensions

- **PCB Dimensions:** 35.0 × 120.0 × 1.6 mm
- **Component Height:** 12.0 mm maximum
- **Probe Tip Length:** 50.0 mm
- **Lead Length:** 1.2 meters

A.2 Connector Pinout

Power Connector:

- **Pin 1 (Red):** VCC (+3.3V to +5.5V)
- **Pin 2 (Black):** GND (0V reference)

Probe Tip:

- **Center:** Signal input
- **Shield:** Connected to GND

APPENDIX B: CIRCUIT DESCRIPTION

B.1 Block Diagram Analysis

The instrument consists of four main functional blocks:

1. **Input Buffer:** High-impedance FET input stage
2. **Threshold Generator:** Proportional voltage divider network
3. **Comparator Array:** LM339 quad comparator implementation
4. **Output Drivers:** LED and buzzer drive circuits

B.2 Component Selection Rationale

LM339 Quad Comparator:

- Single supply operation
- Low power consumption
- Open collector outputs
- Wide supply voltage range

Threshold Network (R5, R6, R7):

- Creates 0.3×VCC and 0.7×VCC references
- Proportional scaling with supply voltage
- Temperature stable operation

APPENDIX C: APPLICATION NOTES

C.1 Logic Family Compatibility

TTL Logic Family:

- VCC = 5.0V
- VIL = 0.8V (max), VIH = 2.0V (min)
- Probe thresholds: VIL = 1.5V, VIH = 3.5V
- Compatibility: Excellent

CMOS Logic Family:

- VCC = 5.0V
- VIL = 1.5V (max), VIH = 3.5V (min)
- Probe thresholds: VIL = 1.5V, VIH = 3.5V
- Compatibility: Excellent

3.3V LVCMOS:

- VCC = 3.3V
- VIL = 0.8V (max), VIH = 2.0V (min)
- Probe thresholds: VIL = 1.0V, VIH = 2.3V
- Compatibility: Good with margin

C.2 Measurement Limitations

High Frequency Signals:

- Maximum reliable frequency: 10 MHz
- Rise/fall time requirements: >50ns
- Pulse width requirements: >1µs for detection

Low Voltage Signals:

- Minimum detectable swing: 1V
- Noise immunity: 50mV typical
- Input offset: <10mV maximum

APPENDIX D: EDUCATIONAL APPLICATIONS

D.1 Laboratory Exercises

Exercise 1: Logic Family Comparison

- Objective: Compare TTL and CMOS logic levels
- Equipment: LP-3355, function generator, oscilloscope
- Procedure: Generate signals at different voltage levels
- Analysis: Compare probe indication with oscilloscope measurements

Exercise 2: Propagation Delay Measurement

- Objective: Measure gate propagation delays
- Equipment: LP-3355, logic gates, pulse generator
- Procedure: Monitor input and output simultaneously
- Analysis: Calculate and compare propagation delays

Exercise 3: Clock Distribution Analysis

- Objective: Analyze clock signal distribution in digital systems
- Equipment: LP-3355, microcontroller development board
- Procedure: Probe various clock distribution points
- Analysis: Verify clock integrity throughout system

D.2 Troubleshooting Scenarios

Scenario 1: Intermittent System Operation

- Symptoms: System works sometimes, fails other times
- Investigation: Use pulse detection to monitor clock stability
- Resolution: Identify intermittent clock or power supply issues

Scenario 2: Logic Level Problems

- Symptoms: Digital inputs not recognized properly
- Investigation: Verify logic levels at input pins
- Resolution: Identify voltage level compatibility issues

REVISION HISTORY

Version	Date	Changes	Author
1.0	2025-09-01	Initial release	Design Engineering

END OF DOCUMENT

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