



Lead Free HASL Process

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PCI Specialty Chemistry

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Alloy Considerations

- Processing Temperatures
- Equipment Considerations
- Chemistry Requirements

Alloy Considerations

- No Universal Alloy to Replace 63/37 Sn/Pb
- Leading Candidates
 - Tin Silver Sn/Ag
 - Tin Copper Sn/Cu

Sn 3.9 Ag 0.6 Cu

- Leading Candidate
- Assemblers Preference
- NEMI Studies
- 217°C Eutectic Temperature

Sn 99.3/Cu 0.7

- Most Economical Solution
- Good Processing Characteristics
- 227°C Eutectic Temperature
- Alloy Bath Contamination at 0.85

HASL Temperatures

- Alloy Bath Temperature 265°C
- (Hot) Air Temperature \approx 300°C
- Transition Temperatures
 - Pre Heat is Critical
 - Cool Down – Minimize Shock

Equipment Considerations

- Materials of Construction
- Heating Capacity
 - Solder Pot
 - Air Knives

Materials of Construction

- Solder Pots of Cold Roll Steel are Still the Most Viable
 - Withstand required temperatures
 - Compatible with alloys and chemistry

No other major component material issues so far

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Heating Capacity

- Main Consideration is Higher Watt Density Heaters
 - Solder pot
 - Air (knives or heater block)
- Total Delta for Solder Operating Temp is 15° C (5.6% Δ)
- Preheating Can be Increased by Increasing Temperature, Longer P.H. Section or Reduced Speed/Extended Dwell

Chemistry Requirements

- Thermal Stability
- Higher Flashpoints
- Evaporation Rate (volatiles)
- Chemistry Maintenance/replenishment
- Cost Implications

No Lead Chemistry

- Thermal Stability and Pot Life
- Flash points – Standard Oils 182° C - 265° C
NL Oils 300° C - 500° C
- Evaporation of Volatiles
 - Higher preheat requirements (horizontal)
 - Can result in increased viscosity which will result in exposed copper
 - SG replenishment systems

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Process Controls and Concerns

- Thermal Energy Transfer
- Need to get Heat into the Panel
- Hole Clearing
- Alloy Cosmetics
- Co planarity

Thermal Energy Transfer

- Preheating (horizontal)
- Solder Temperature Increase
- Solder Dwell/Contact Time

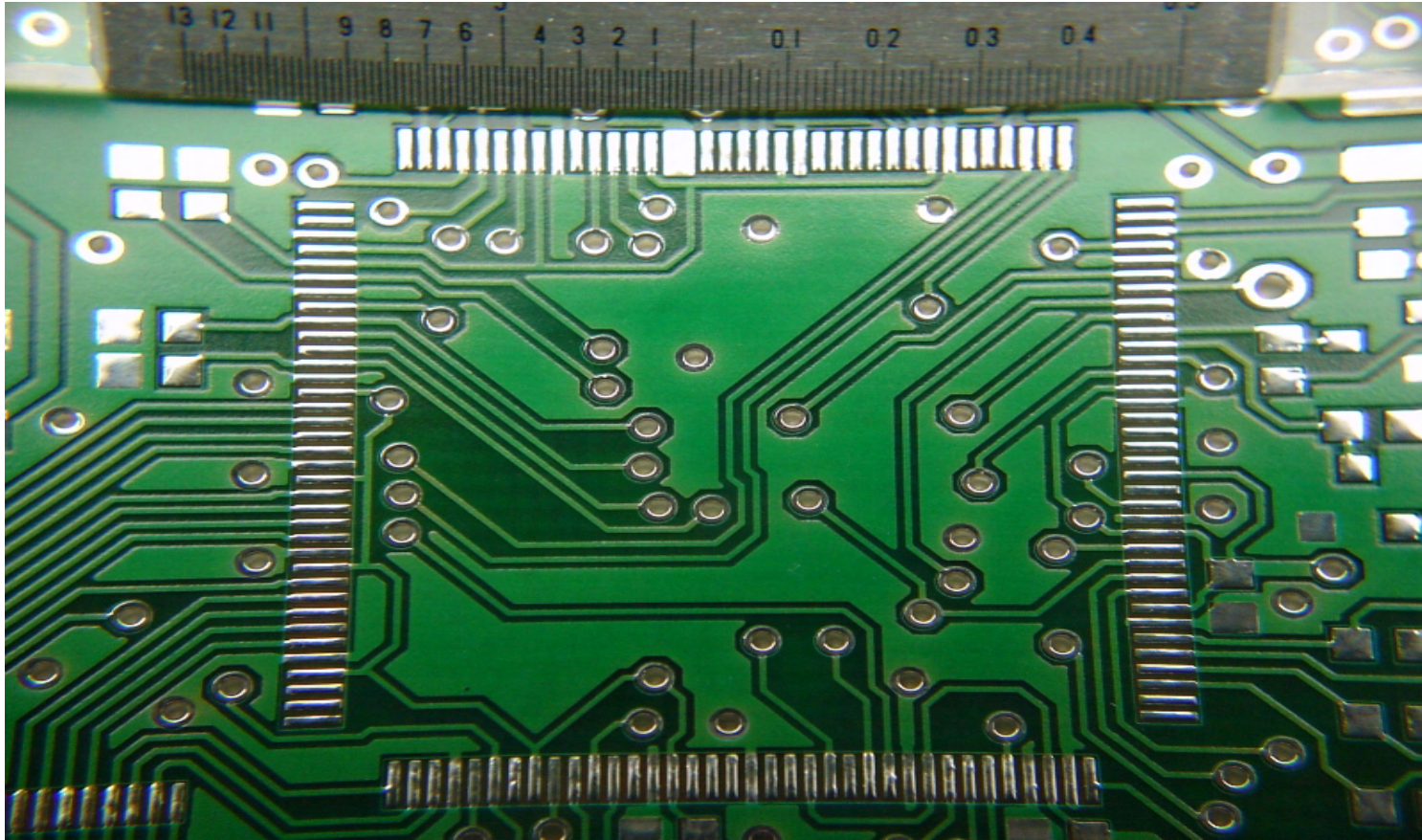
Some Positives

- Hole Clearing
 - Better than Sn/Pb
- Surface Finish
 - Better Co planarity
 - Twice the minimum of Sn/Pb
 - 1/2 the maximum of Sn/Pb

Considerations for Transition

- Using Existing HASL Equipment
 - Sn/Pb residual in solder pot
 - Heater capacity
 - Overall capability (age/condition)
- Second Processing Line
 - For use during transition period
 - For customer approvals
 - Process refinement

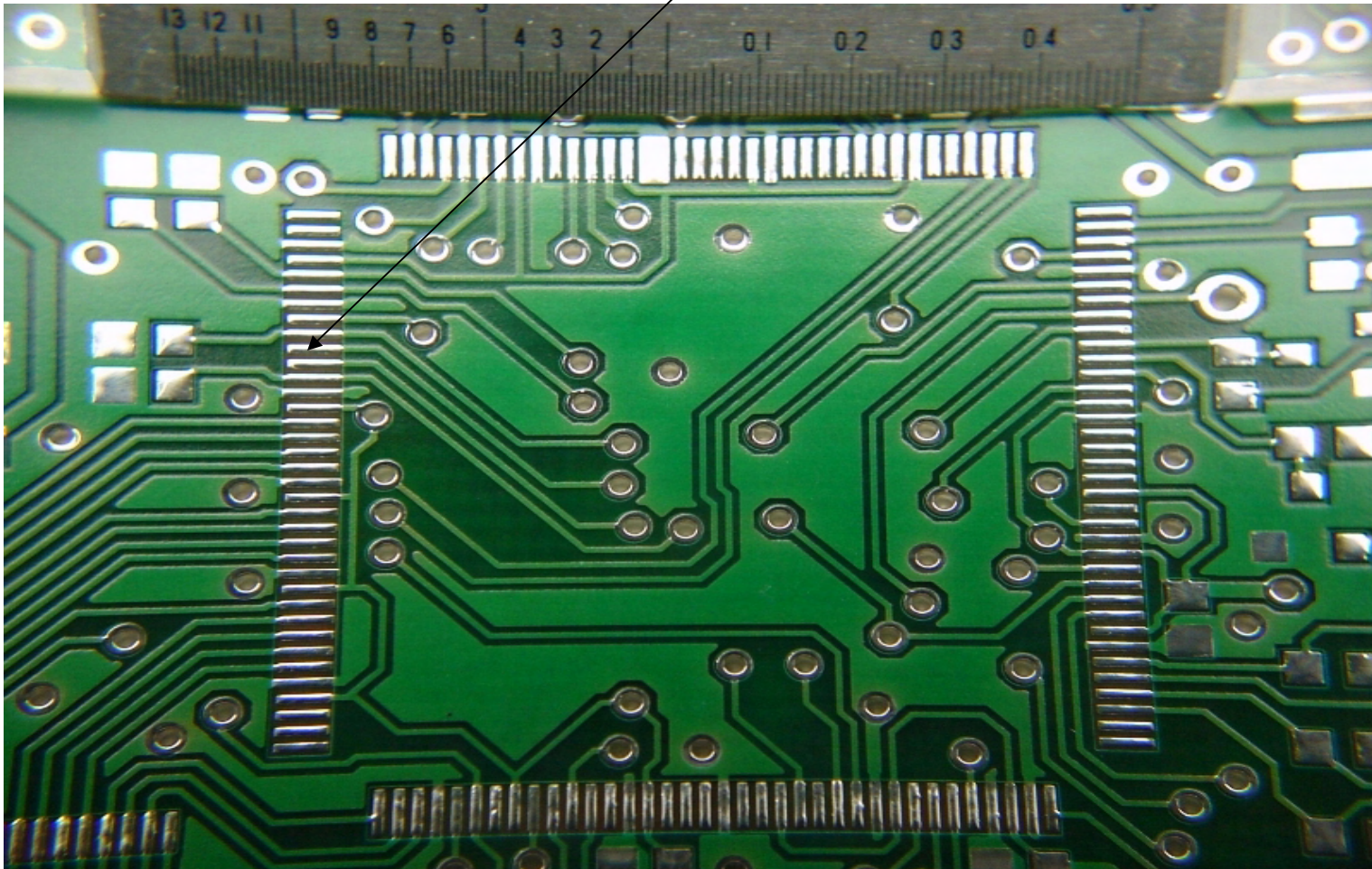
Front Side- Control Feature



The machine was set with the lowest pressure settings required to level this feature consistently.

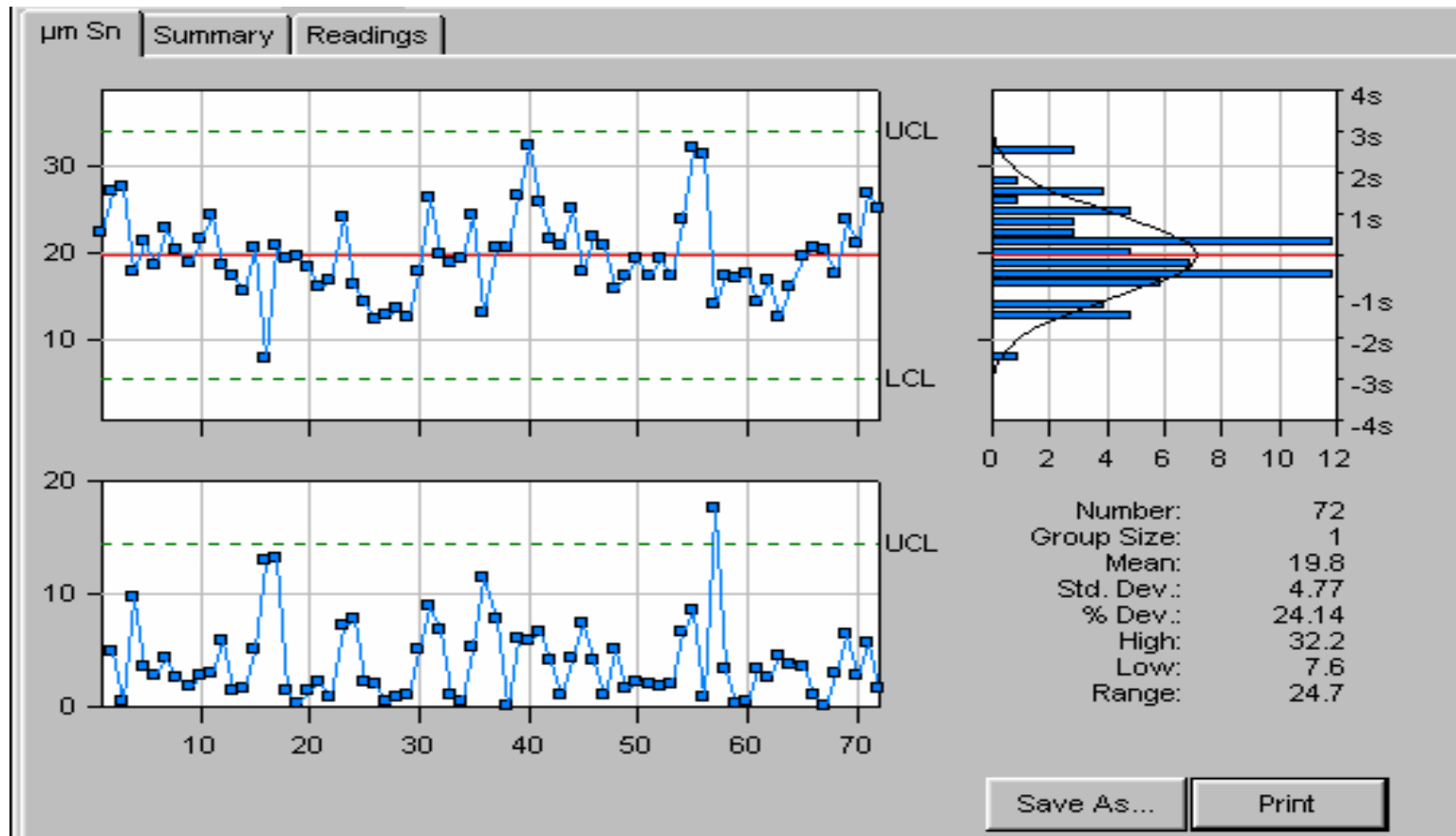
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Horizontal axis XRF data.



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Horizontal Axis XRF Analysis



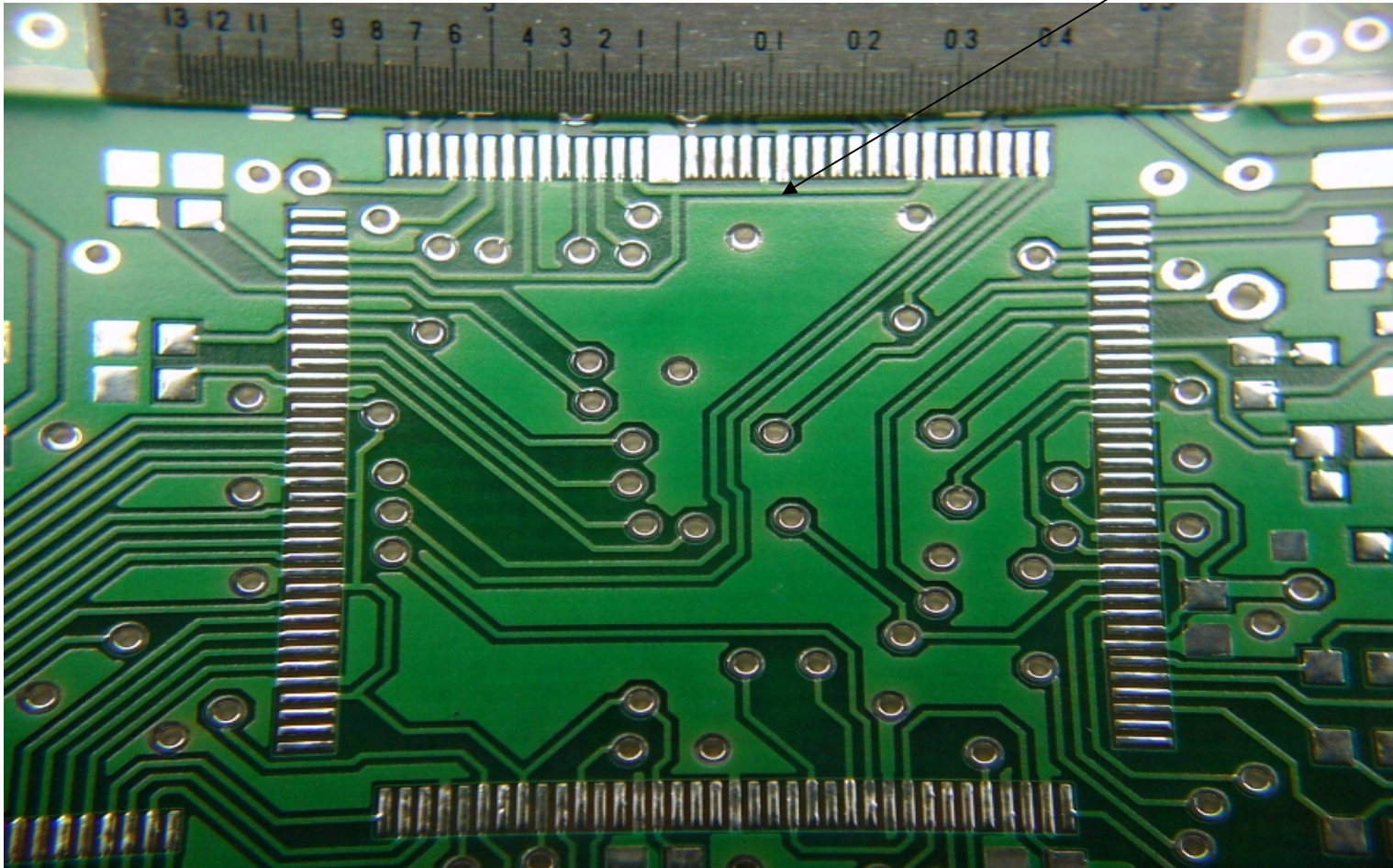
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Horizontal Axis XRF Readings

Number	Result (um Sn)	Number	Result (um Sn)	Number	Result (um Sn)
001	22.2	026	12.3	051	17.4
002	27.0	027	12.8	052	19.1
003	27.5	028	13.5	053	17.3
004	17.9	029	12.6	054	23.8
005	21.3	030	17.7	055	32.2
006	18.6	031	26.4	056	31.4
007	22.9	032	19.7	057	13.9
008	20.4	033	18.7	058	17.3
009	18.7	034	19.1	059	17.1
010	21.4	035	24.3	060	17.5
011	24.4	036	13.0	061	14.2
012	18.6	037	20.6	062	16.7
013	17.2	038	20.5	063	12.4
014	15.6	039	26.4	064	16.0
015	20.5	040	32.2	065	19.4
016	7.6	041	25.7	066	20.4
017	20.7	042	21.6	067	20.4
018	19.3	043	20.7	068	17.6
019	19.5	044	25.0	069	23.9
020	18.2	045	17.6	070	21.1
021	16.1	046	21.7	071	26.7
022	16.8	047	20.7	072	25.1
023	24.0	048	15.7		
024	16.3	049	17.2		
025	14.3	050	19.3		

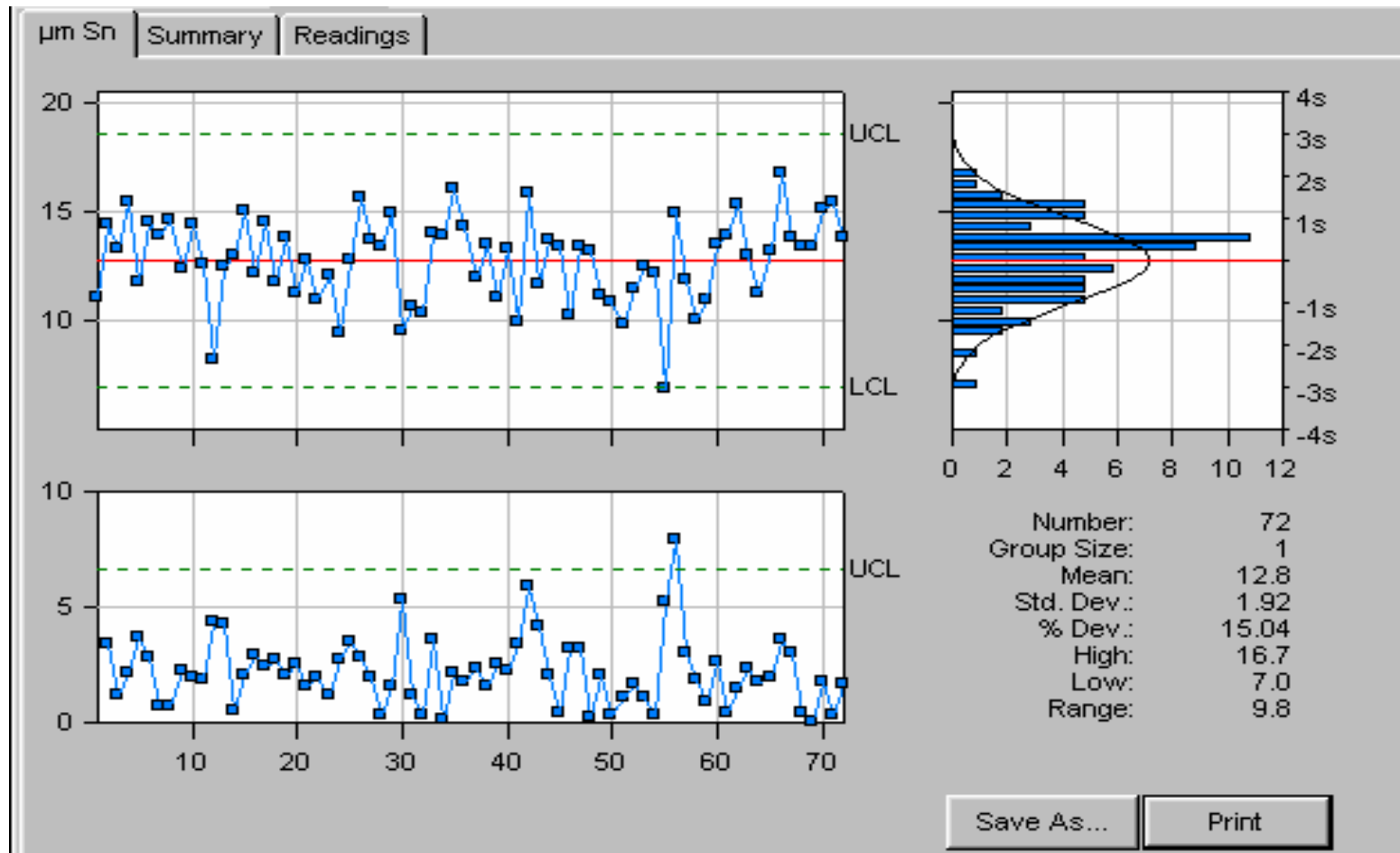
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Vertical axis XRF data.



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Vertical Axis XRF Analysis



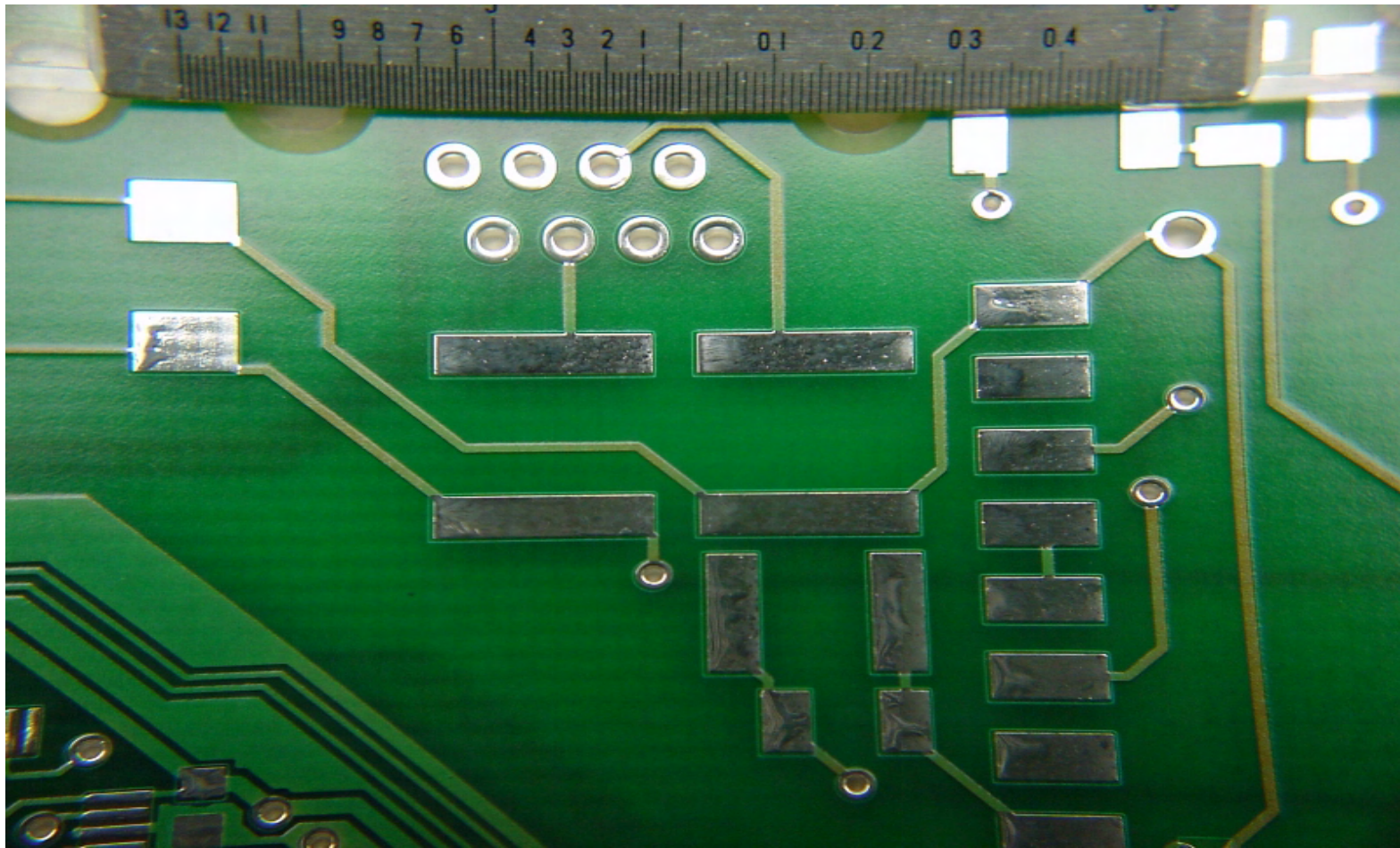
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Vertical Axis XRF Readings

Number	Result (um Sn)	Number	Result (um Sn)	Number	Result (um Sn)
001	11.1	026	15.6	051	9.8
002	14.4	027	13.7	052	11.4
003	13.3	028	13.4	053	12.5
004	15.4	029	14.9	054	12.1
005	11.7	030	9.6	055	7.0
006	14.5	031	10.7	056	14.9
007	13.9	032	10.4	057	11.9
008	14.6	033	14.0	058	10.0
009	12.4	034	13.9	059	10.9
010	14.4	035	16.0	060	13.5
011	12.6	036	14.3	061	13.9
012	8.2	037	12.0	062	15.3
013	12.5	038	13.5	063	13.0
014	13.0	039	11.0	064	11.3
015	15.0	040	13.3	065	13.2
016	12.1	041	9.9	066	16.7
017	14.5	042	15.8	067	13.8
018	11.8	043	11.6	068	13.3
019	13.8	044	13.7	069	13.4
020	11.3	045	13.3	070	15.1
021	12.8	046	10.2	071	15.4
022	10.9	047	13.4	072	13.7
023	12.1	048	13.2		
024	9.4	049	11.2		
025	12.8	050	10.9		

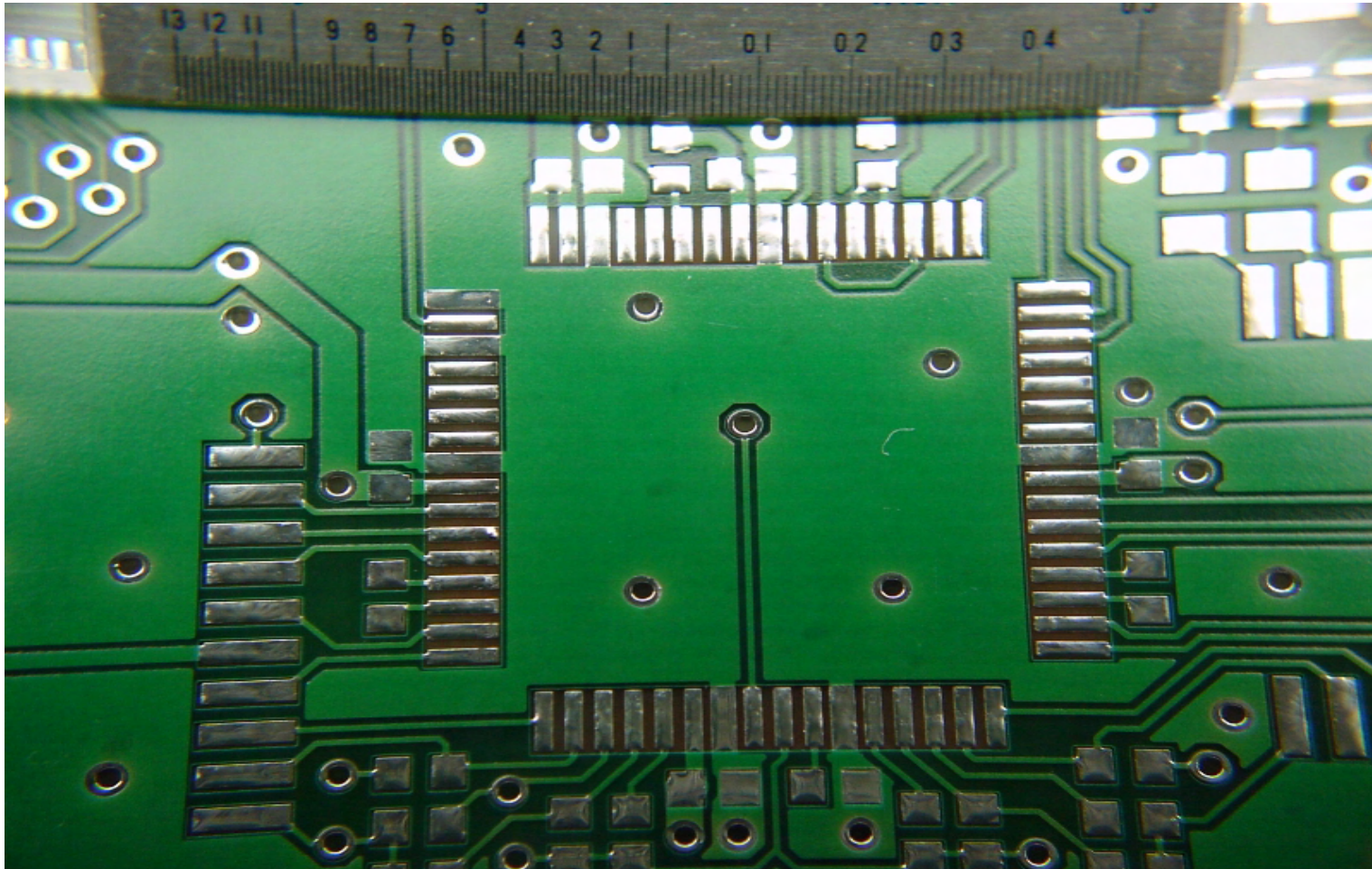
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Front side-One.



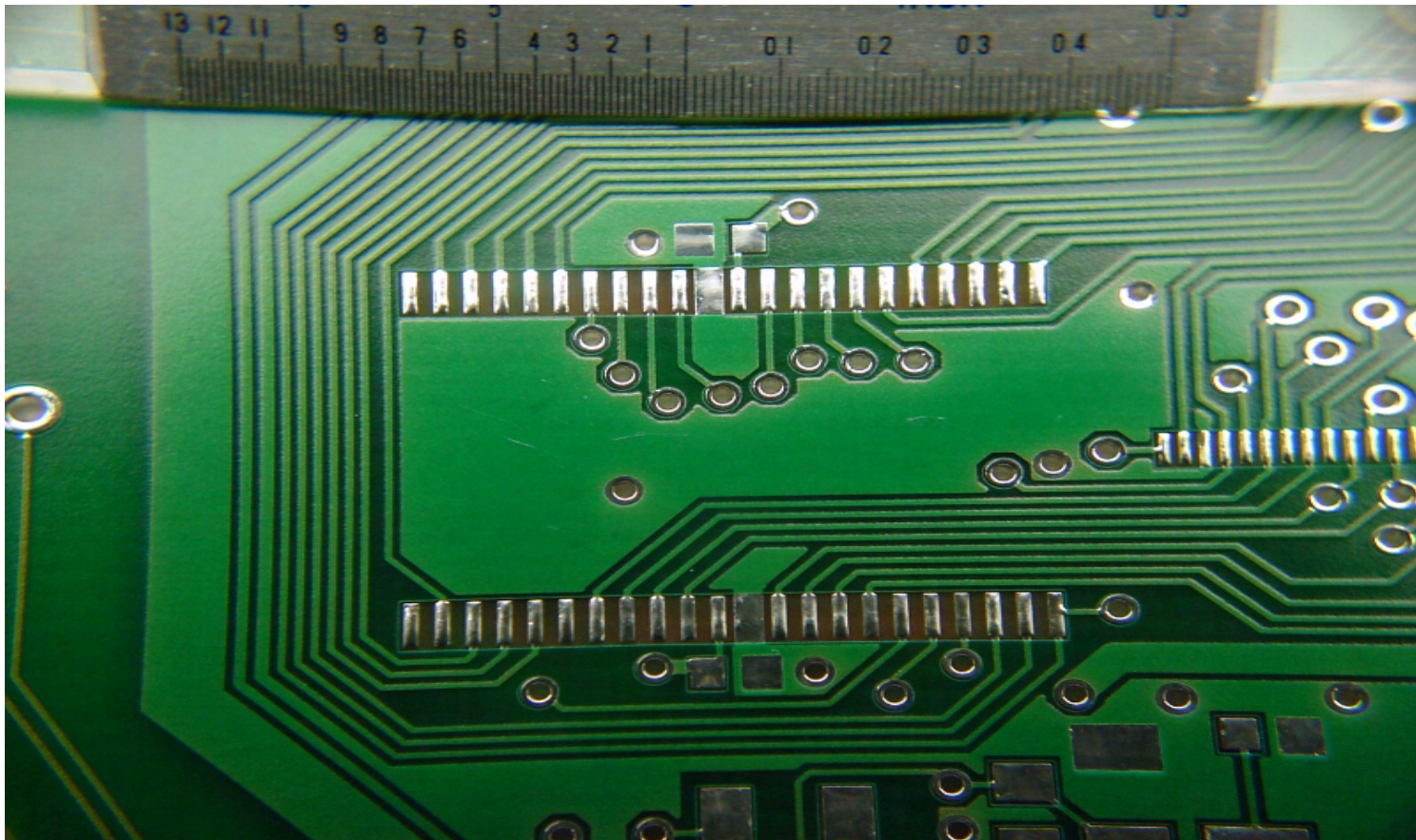
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Front Side-Two.



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Front Side-Three



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