VISHAY

One of the World's Largest Manufacturers
of Discrete Semiconductors and Passive Components

Production Part Approval Process

The following PPAP documentation is assembled according to the AIAG, 4th Edition PPAP Manual and applicable customer requirements

IHLE4040xxERxxxM5A

Generic PPAP

Generic PPAP

10/16/2017

Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

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Vishay / Dale Electronics
1505 East Hway 50 Yankton, SD 57078, USA Phone (605) 665-9301 Fax (605) 668-4247

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Note: Generic PPAPs do not include all sections shown in the Table of Contents.
Sections 4,5,6,7,8,12,&18 are only available upon request of a full Automotive PPAP.

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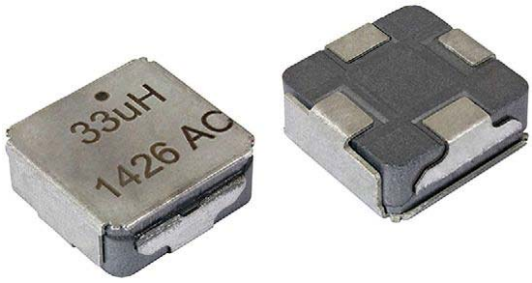
Section 1. Design Records

Vishay / Dale Electronics
1505 East Hway 50 Yankton, SD 57078, USA Phone (605) 665-9301 Fax (605) 668-4247
ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS

Low Profile, High Current Inductors with e-field Shield



DESIGN SUPPORT TOOLS click logo to get started

Design Tools Available

FEATURES

- High temperature, up to 155 °C
- Integrated E-Shield for maximum EMI reduction (1)
- Excellent DC/DC energy storage up to 1 MHz to 2 MHz. Filter inductor applications up the SRF (see Standard Electrical Specifications table).
- Integrated e-field shield eliminates need for separate shielding
- 20 dB e-field reduction at 1 cm
  - Measured vertically from top center of device
- Lowest DCR/µH, in this package size
- Handles high transient current spikes without saturation
- Coplanarity of the 4 terminals ≤ 100 µm
- AEC-Q200 qualified
- **Patent pending**
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Note

(1) Maximum e-field reduction is realized with the IHLE shield is connected to ground.

APPLICATIONS

- Engine and transmission control units
- Diesel injection drivers
- DC/DC converters for entertainment/navigation systems
- Noise suppression for motors: windshield wipers / power seats / power mirrors / heating and ventilation blower / HID lighting
- LED drivers

STANDARD ELECTRICAL SPECIFICATIONS

L_0 INDUCTANCE ± 20 % AT 100 kHz, 0.25 V, 0 A (µH)	DCR TYP. 25 °C (mΩ)	DCR MAX. 25 °C (mΩ)	HEAT RATING CURRENT DC TYP. (A) (1)	SATURATION CURRENT DC TYP. (A) (2)	SRF TYP. (MHz)
0.47	1.55	1.66	30.0	28.5	72.1
1.0	2.87	3.07	23.5	24.0	37.2
1.5	4.2	4.5	22.0	17.9	32
2.2	8.15	8.76	15.0	12.0	30.1
3.3	11.0	11.81	11.0	12.0	25.5
4.7	14.3	15.32	9.8	9.2	20.1
5.6	16.5	17.60	9.3	9.0	16.3
6.8	20.9	22.36	9.1	9.0	16.3
10	30.9	33.06	6.5	8.5	11.5
15	47.0	50.29	5.1	7.7	10.4
22	70.5	75.44	4.1	6.4	8.30
33	110	117.70	3.7	4.2	5.79
47	167	178	3.1	4.1	5.22
68	240	252	2.4	3.5	4.02

Notes

- All test data is referenced to 25 °C ambient
- Operating temperature range -55 °C to +125 °C
- The part temperature (ambient + temp. rise) should not exceed 125 °C under worst case operating conditions. Circuit design, component placement, PWB trace size and thickness, airflow and other cooling provisions all affect the part temperature. Part temperature should be verified in the end application
- Rated operating voltage (across inductor) = 50 V

(1) DC current (A) that will cause an approximate ΔT of 40 °C

(2) DC current (A) that will cause L_0 to drop approximately 20 %

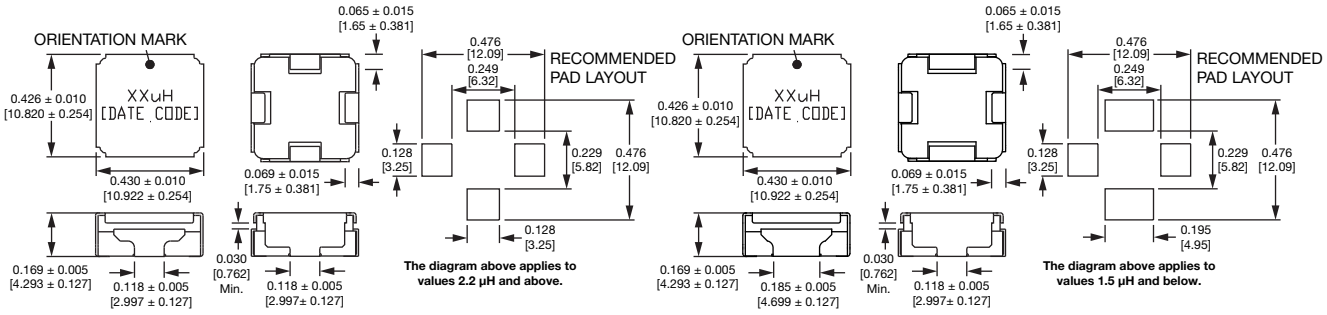
DESCRIPTION

IHLE-4040DD-5A	33 µH	± 20 %	ER	e3
MODEL	INDUCTANCE VALUE	INDUCTANCE TOLERANCE	PACKAGE CODE	JEDEC® LEAD (Pb)-FREE STANDARD

GLOBAL PART NUMBER

I	H	L	E	4	0	4	0	D	D	E	R	3	3	0	M	5	A
PRODUCT FAMILY				SIZE						PACKAGE CODE		INDUCTANCE VALUE			TOL.	SERIES	

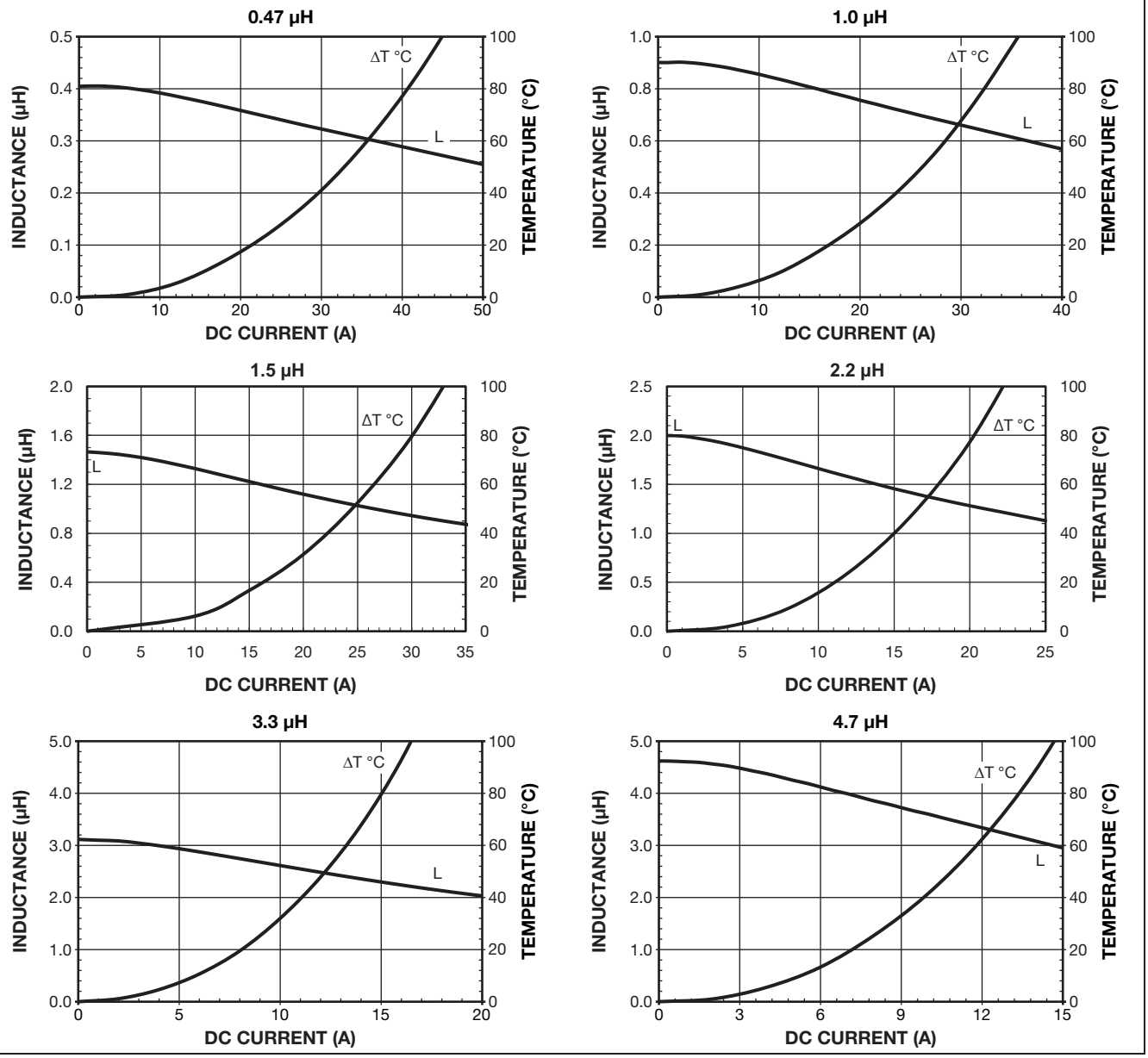
DIMENSIONS in inches [millimeters]



Notes

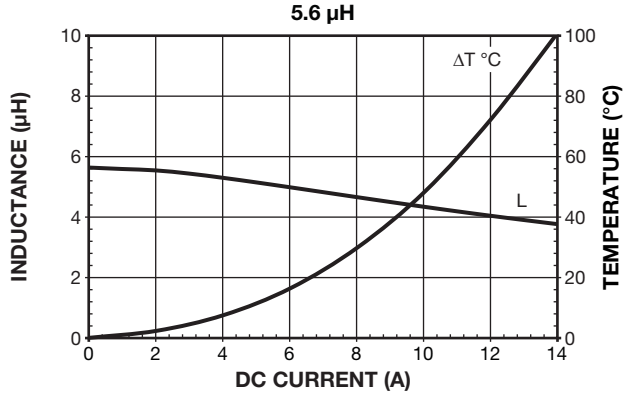
- Dot indicate the coil pin
- Coplanarity of 4 terminals: 0.004” [0.10]

PERFORMANCE GRAPHS

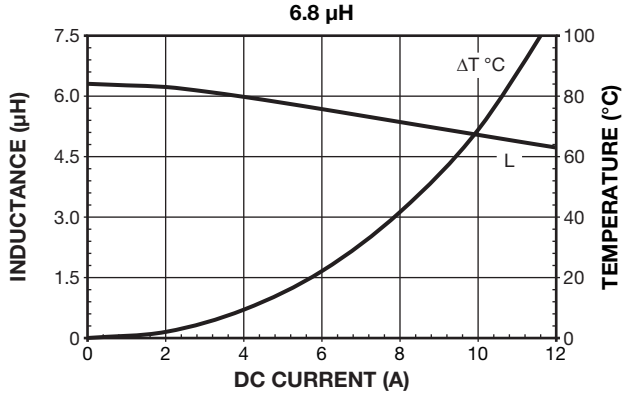


PERFORMANCE GRAPHS

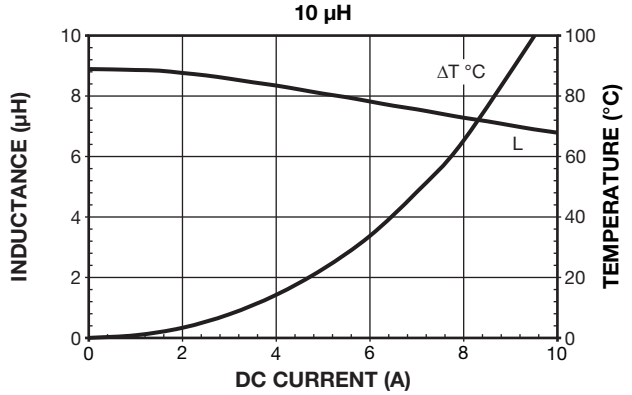
5.6 µH



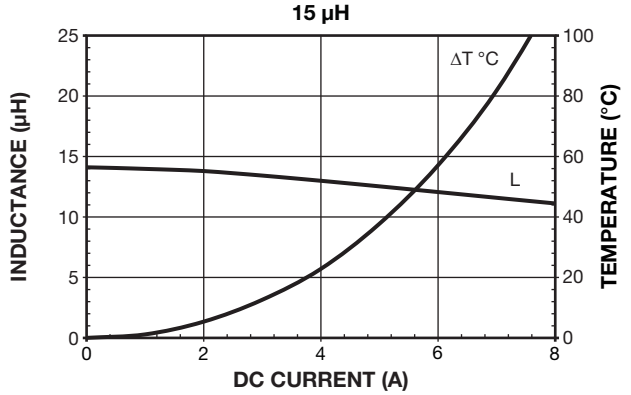
6.8 µH



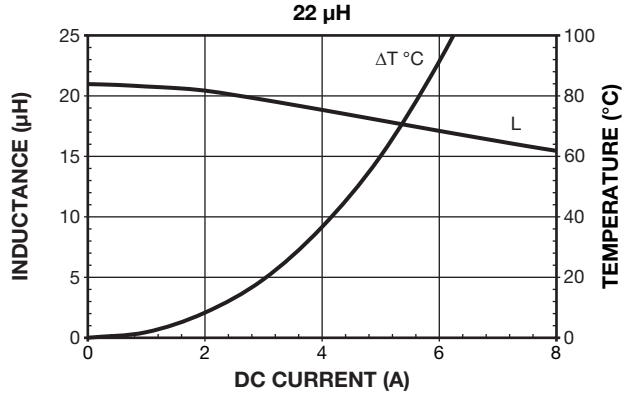
10 µH



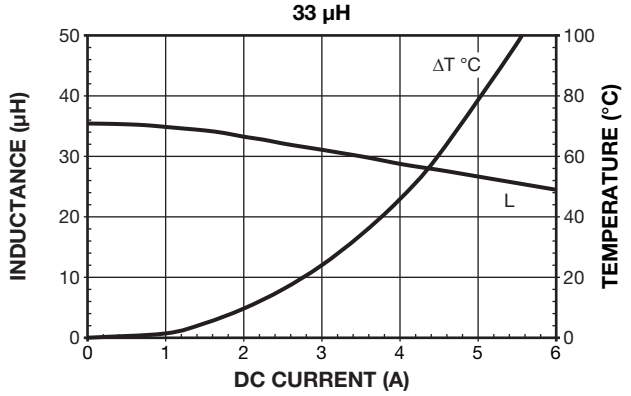
15 µH



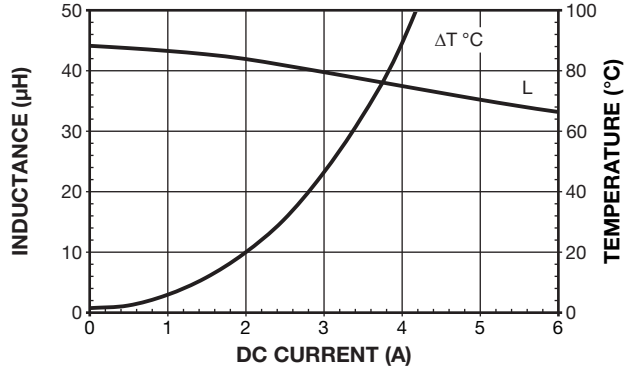
22 µH



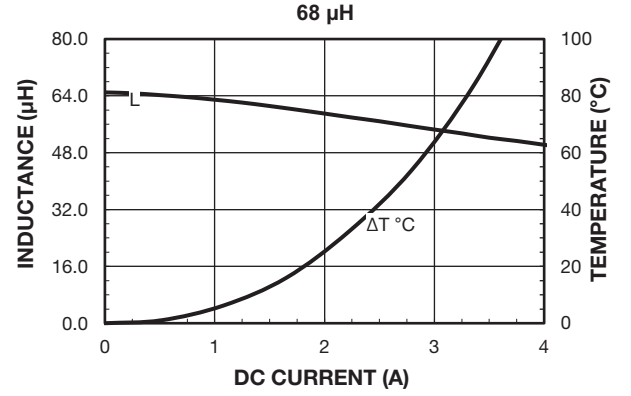
33 µH



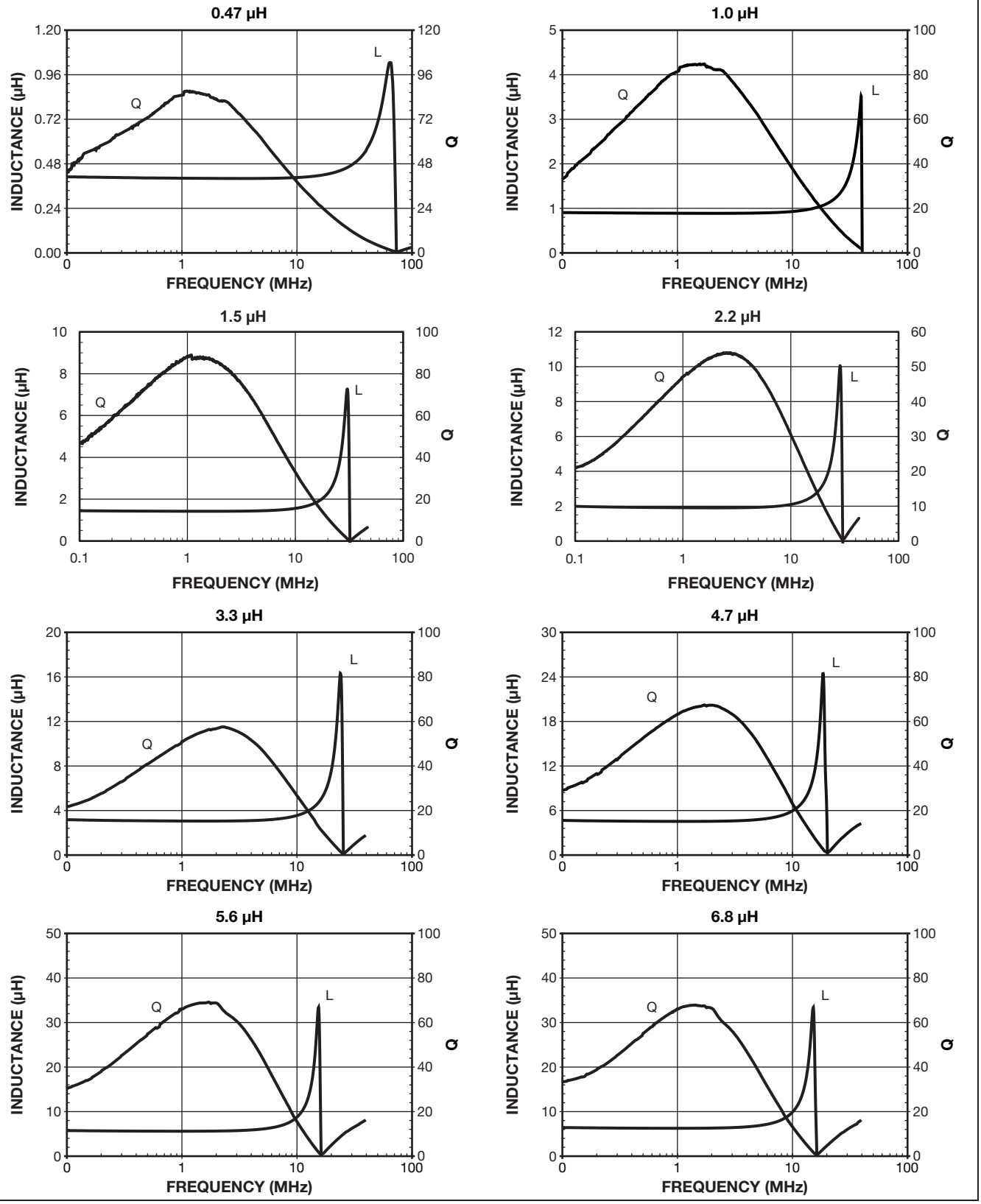
47 µH



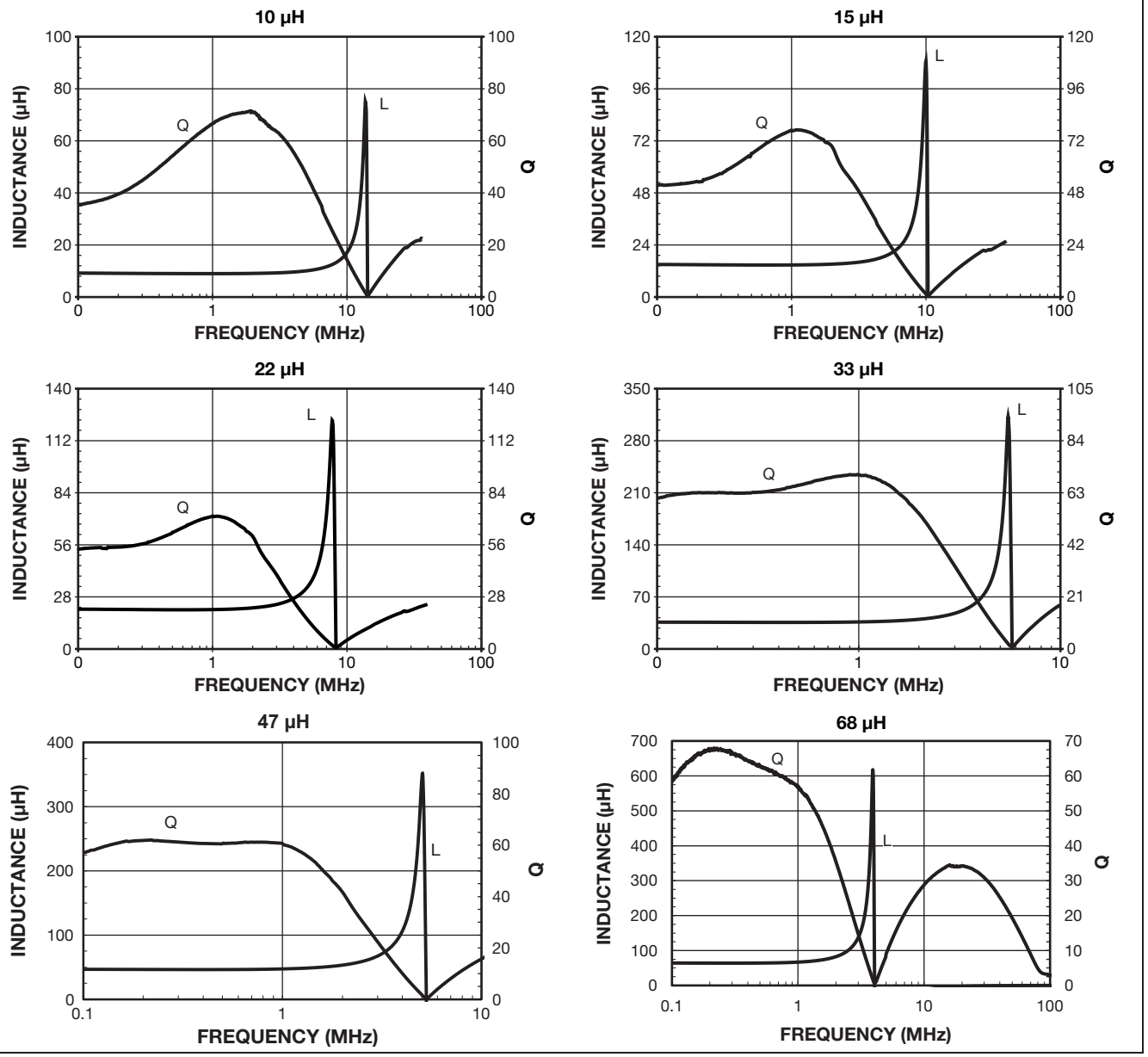
68 µH



PERFORMANCE GRAPHS: INDUCTANCE AND Q VS. FREQUENCY

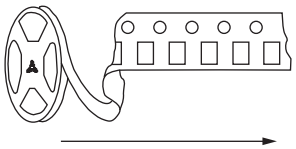


PERFORMANCE GRAPHS: INDUCTANCE AND Q VS. FREQUENCY

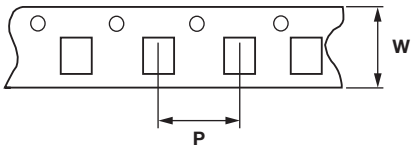


SMD Magnetics Packaging Methods

TAPE AND REEL in inches [millimeters] - Meets EIA RS-481 tape and reel packaging standard



User Direction of Feed



Carrier Dimensions

MODEL	PACKAGE CODE			REEL SIZE	CARRIER TAPE WIDTH (W)	COMPONENT PITCH (P)	UNITS/ REEL	PACKAGE CODE			UNITS/ BULK
	PREVIOUS CODE	GLOBAL CODE LEAD (Pb)-BEARING	GLOBAL CODE LEAD (Pb)-FREE					PREVIOUS CODE	GLOBAL CODE LEAD (Pb)-BEARING	GLOBAL CODE LEAD (Pb)-FREE	
IHLP-1212ABER	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	3000	-	-	-	-
IHLP-1212ABEV	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	4000	-	-	-	-
IHLP-1212AEER	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	3000	-	-	-	-
IHLP-1212BZER	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	3000	-	-	-	-
IHLP-1212BZEV	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	4000	-	-	-	-
IHLP-1616AB	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	4000	-	-	EB	100
IHLP-1616BZ	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	4000	-	-	EB	100
IHLP-2020AB	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	4000	-	-	EB	100
IHLP-2020BZ	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	2000	-	-	EB	100
IHLP-2020CZ	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	2000	-	-	EB	100
IHLP-2525AH	-	-	ER	13	0.630 [16.0]	0.315 [8.0]	2000	-	-	EB	100
IHLP-2525BD	-	-	ER	13	0.630 [16.0]	0.315 [8.0]	2000	-	-	EB	100
IHLP-2525CZ	-	-	ER	13	0.630 [16.0]	0.315 [8.0]	2000	-	-	EB	100
IHLP-2525EZ	-	-	ER	13	0.630 [16.0]	0.472 [12.0]	500	-	-	EB	100
IHLP-3232CZ	-	-	ER	13	0.630 [16.0]	0.472 [12.0]	1000	-	-	EB	100
IHLP-3232DZ	-	-	ER	13	0.630 [16.0]	0.472 [12.0]	500	-	-	EB	100
IHLP-4040DZ	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	500	-	-	EB	100
IHLP-5050CE	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	500	-	-	EB	100
IHLP-5050EZ	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	250	-	-	EB	100
IHLP-5050FD	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	250	-	-	EB	100
IHLP-6767DZ	-	-	ER	13	0.945 [24.0]	0.945 [24.0]	250	-	-	EB	100
IHLP-6767GZ	-	-	ER	13	0.945 [24.0]	0.945 [24.0]	200	-	-	EB	100
IHLP-8787MZ	-	-	ER	13	1.73 [44.0]	1.26 [32.0]	100	-	-	-	-
IHCL-4040DZ	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	500	-	-	EB	100
IHLD-4032KB	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	250	-	-	EB	100
IHLD-3232HB	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	250	-	-	EB	100
IHLE-2525CD	-	-	ER	13	0.630 [16.0]	0.315 [8.0]	2000	-	-	EB	100
IHLE-3232DD	-	-	ER	13	0.630 [16.0]	0.472 [12.0]	500	-	-	EB	100
IHLE-4040DD	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	500	-	-	EB	100
IHLR-4040DZ	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	500	-	-	EB	100
IHLM-2525CZ	-	-	ER	13	0.630 [16.0]	0.315 [8.0]	2000	-	-	EB	100
IHLW-4040CF	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	500	-	-	EB	100
IHLW-5050CE	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	500	-	-	EB	100
IFLP-4040DZ	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	500	-	-	EB	100
IFLR-2727EZ	-	-	ER	13	0.630 [16.0]	0.630 [16.0]	1000	-	-	-	-
IFLR-4027EZ	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	1000	-	-	-	-
IFLR-4031GC	-	-	ER	13	0.945 [24.0]	0.472 [12.0]	500	-	-	EB	100
IFLR-5151HZ	-	-	ER	13	0.945 [24.0]	0.630 [16.0]	450	-	-	EB	100

TAPE AND REEL in inches [millimeters] - Meets EIA RS-481 tape and reel packaging standard											
	PACKAGE CODE							PACKAGE CODE			
MODEL	PREVIOUS CODE	GLOBAL CODE LEAD (Pb)-BEARING	GLOBAL CODE LEAD (Pb)-FREE	REEL SIZE	CARRIER TAPE WIDTH (W)	COMPONENT PITCH (P)	UNITS/ REEL	PREVIOUS CODE	GLOBAL CODE LEAD (Pb)-BEARING	GLOBAL CODE LEAD (Pb)-FREE	UNITS/ BULK
IFSC-0806AZ	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	2000	-	-	-	-
IFSC-1008AB	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	2000	-	-	-	-
IFSC-1111AZ	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	2000	-	-	-	-
IFSC-1111AB	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	2000	-	-	-	-
IFSC-1515AH	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	2000	-	-	-	-
IHHP-0806AZ-01	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	2000	-	-	-	-
IHHP-0806AB-01	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	2000	-	-	-	-
IHHP-1008AZ-01	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	3000	-	-	-	-
IHHP-1008AB-01	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	3000	-	-	-	-
IHHP-1212ZH-01	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	3000	-	-	-	-
IHHP-1212AZ-01	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	3000	-	-	-	-
IHSM-3825	RC2	RE	ER	13	0.945 [24.0]	0.472 [12.0]	750	P09	PJ	EB	100
IHSM-4825	RC2	RE	ER	13	0.945 [24.0]	0.472 [12.0]	750	P09	PJ	EB	100
IHSM-5832	RC3	RF	ER	13	1.26 [32.0]	0.472 [12.0]	500	P09	PJ	EB	100
IHSM-7832	RC4	RG	ER	13	1.73 [44.0]	0.472 [12.0]	500	P09	PJ	EB	100
IDC-2512	-	-	ER	13	0.630 [16.0]	0.315 [8.0]	2000	-	-	-	-
IDC-5020	-	-	ER	13	0.630 [16.0]	0.472 [12.0]	500	-	-	-	-
IDC-7328	-	-	ER	13	0.945 [24.0]	0.945 [24.0]	250	-	-	-	-
IDCS-2512	-	-	ER	13	0.630 [16.0]	0.315 [8.0]	2000	-	-	-	-
IDCS-5020	-	-	ER	13	0.630 [16.0]	0.472 [12.0]	500	-	-	-	-
IDCS-7328	-	-	ER	13	0.945 [24.0]	0.945 [24.0]	250	-	-	-	-
IDCP-1813	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	2000	-	-	-	-
IDCP-2218	-	-	ER	13	0.472 [12.0]	0.315 [8.0]	1500	-	-	-	-
IDCP-3114	-	-	ER	13	0.630 (16.0)	0.472 [12.0]	1000	-	-	-	-
IDCP-3020	-	-	ER	13	0.630 (16.0)	0.472 [12.0]	1000	-	-	-	-
IDCP-3722	-	-	ER	13	0.945 [24.0]	0.472 [12.0]	500	-	-	-	-
IDCP-3916	-	-	ER	13	0.945 [24.0]	0.472 [12.0]	500	-	-	-	-
IFCB-0402	-	-	ER	7	0.315 [8.0]	0.079 [2.0]	10 000	-	-	-	-
ILC-0402	-	-	ER	7	0.315 [8.0]	0.079 [2.0]	10 000	-	-	-	-
ILC-0603	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	4000	-	-	-	-
ILC-0805	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	4000	-	-	-	-
IMC-0402	-	-	ER	7	0.315 [8.0]	0.079 [2.0]	10 000	-	-	-	-
IMC-0402-01	-	-	ER	7	0.315 [8.0]	0.079 [2.0]	10 000	-	-	-	-
IMC-0603	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	4000	-	-	-	-
IMC-0603-01	-	-	ER	7	0.315 [8.0]	0.079 [2.0]	3000	-	-	-	-
IMC-0805-01	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	2000	-	-	-	-
IMC-1008	-	-	ER	7	0.315 [8.0]	0.157 [4.0]	2000	-	-	-	-
IMC-1210	R98/RB3 R99/RB4	SY/AN SZ/R9	ER/ET ES/EU	7 13	0.315 [8.0] 0.315 [8.0]	0.157 [4.0] 0.157 [4.0]	2000 7500	B13	BN	EB	500
IMC-1210-100	R98/RB3 R99/RB4	SY/AN SZ/R9	ER/ET ES/EU	7 13	0.315 [8.0] 0.315 [8.0]	0.157 [4.0] 0.157 [4.0]	2000 7500	B13	BN	EB	500
IMC-1812	R73/R92 R13/R91	RV/RX RQ/RW	ER/ET ES/EU	7 13	0.472 [12.0] 0.472 [12.0]	0.315 [8.0] 0.315 [8.0]	500 2000	B13	BN	EB	500
IMCH-1812	-	-	ER	7	0.472 [12.0]	0.315 [8.0]	500	-	-	-	-
IMC-2220	-	-	ER	13	0.630 [16.0]	0.472 [12.0]	1000	-	-	-	-

IHLP PACKAGING

COMPONENT PHOTO

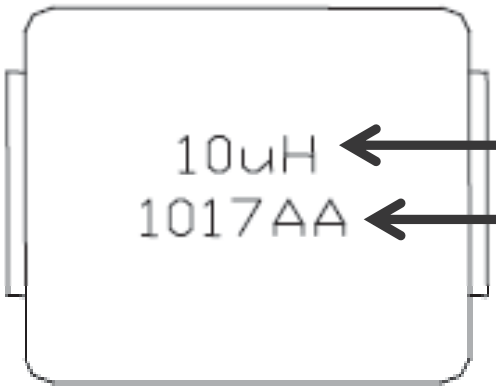
POCKET TAPE PHOTO

REEL PHOTO

CONTAINER PHOTO

UNIT LOAD PHOTO

IHLP COMPONENT PRINT



The Inductance Value

DATE CODE:
1017 = 17th week of 2010
The letters behind the date code are used by Vishay to trace each component back to a specific lot

Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

Terminal Plating Info

Part Number (CUSTOMER)	Part Number (Vishay)	Layer structure with base and coating material used:	Layer thickness and tolerances of the coatings (base material, intermediate layer, final finish)	Kind of Coating or technology (e.g. galvanized, chemically hot tin-plated,..)
Generic PPAP	IHLE4040xxERxxxM5A	Cu - Base Material Ni- Intermediate Later Sn- Finish Layer	CU: 0.203 +/- .0254mm Ni: 1.27um to 3.175um Sn: 4.57um to 6.35 um	Electroplated

Production Part Approval Process

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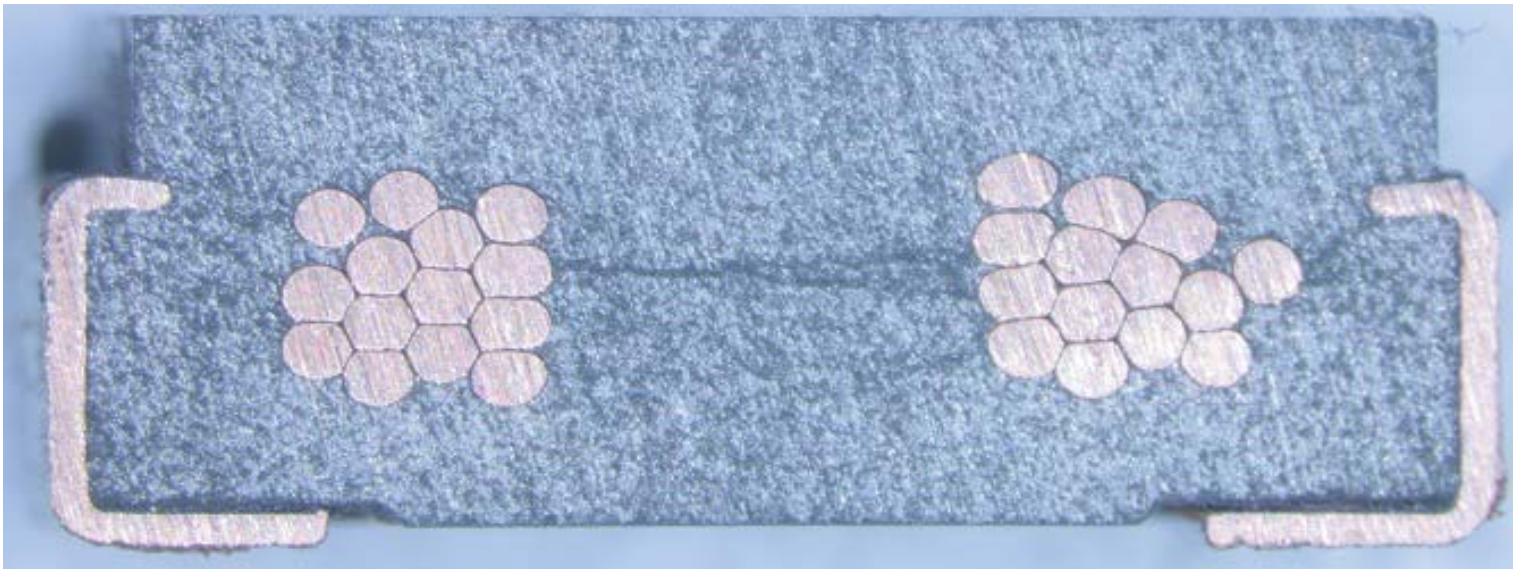
Cross Sectional Picture IHLE4040DD 10uH



Production Part Approval Process

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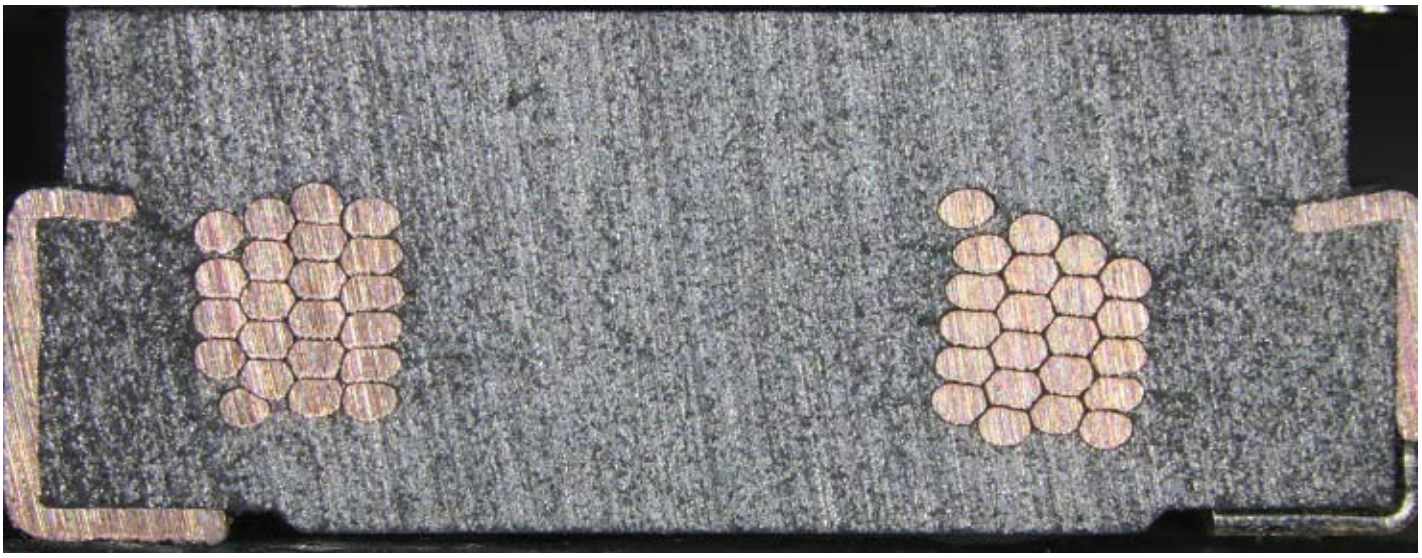
Cross Sectional Picture IHLE4040DD 33uH



Production Part Approval Process

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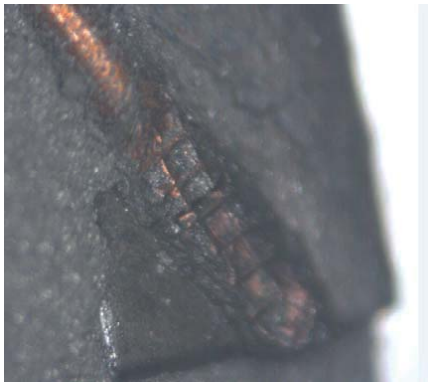
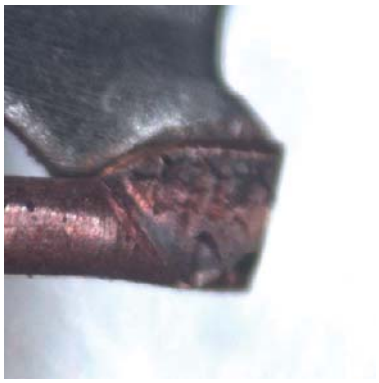
Example Photos of IHLP Welds





Production Part Approval Process

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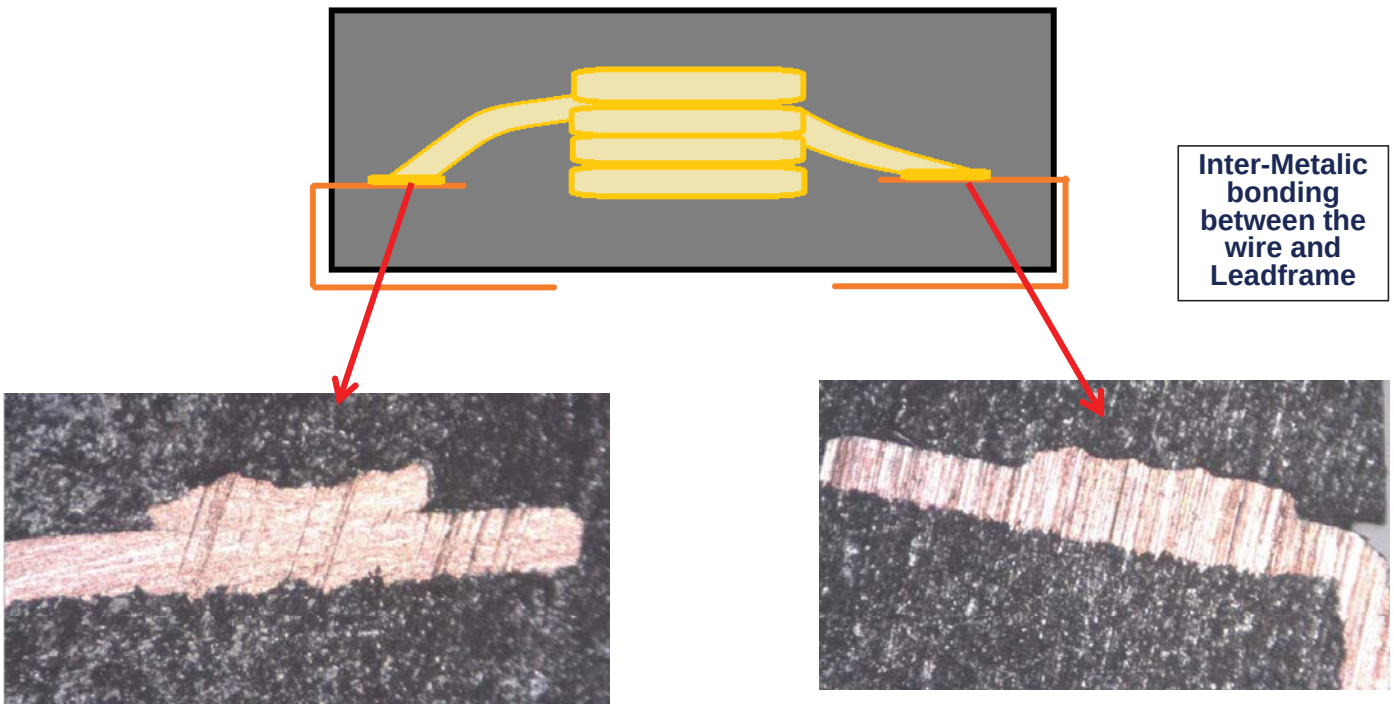
Cross sectional Photos of IHLP Welds



Production Part Approval Process

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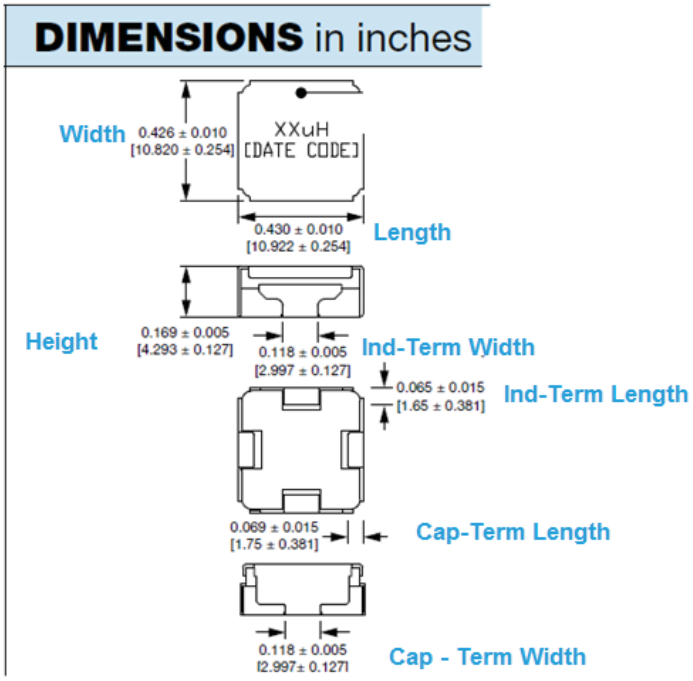
Dimensional Analysis
IHLE-4040DD



Production Part Approval Process

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Dimensional Analysis
IHLE-4040DD

	DIMENSIONS						
#	Width	Length	Height	Term length (Inductor)	Term width (Inductor)	Term length (Shield)	Term width (Shield)
1	0.422	0.427	0.169	0.065	0.119	0.069	0.12
2	0.422	0.428	0.17	0.063	0.119	0.068	0.12
3	0.423	0.428	0.169	0.068	0.12	0.068	0.12
4	0.425	0.427	0.17	0.069	0.119	0.068	0.12
5	0.423	0.427	0.17	0.063	0.119	0.072	0.12
6	0.424	0.427	0.169	0.067	0.119	0.073	0.12
7	0.424	0.427	0.169	0.065	0.119	0.067	0.119
8	0.424	0.427	0.169	0.069	0.119	0.067	0.12
9	0.423	0.427	0.168	0.066	0.12	0.069	0.12
10	0.423	0.428	0.168	0.069	0.119	0.066	0.12
11	0.423	0.428	0.17	0.066	0.119	0.071	0.12
12	0.424	0.427	0.169	0.07	0.119	0.066	0.12
13	0.424	0.427	0.169	0.066	0.119	0.068	0.12
14	0.423	0.427	0.169	0.068	0.119	0.069	0.12
15	0.422	0.428	0.169	0.067	0.119	0.069	0.12
16	0.423	0.428	0.171	0.067	0.119	0.069	0.12
17	0.422	0.427	0.169	0.067	0.12	0.072	0.12
18	0.422	0.427	0.169	0.063	0.119	0.071	0.12
19	0.423	0.427	0.17	0.066	0.119	0.071	0.12
20	0.423	0.427	0.17	0.067	0.119	0.073	0.12
21	0.426	0.427	0.169	0.069	0.119	0.068	0.12
22	0.423	0.428	0.169	0.069	0.119	0.068	0.12
23	0.424	0.429	0.168	0.068	0.119	0.07	0.12
24	0.422	0.427	0.169	0.066	0.119	0.065	0.119
25	0.423	0.427	0.171	0.068	0.119	0.07	0.12
26	0.423	0.428	0.168	0.069	0.12	0.069	0.12
27	0.422	0.428	0.169	0.066	0.12	0.067	0.12
28	0.423	0.427	0.17	0.071	0.119	0.071	0.12
29	0.422	0.428	0.169	0.063	0.119	0.07	0.12
30	0.423	0.429	0.169	0.07	0.119	0.072	0.12
31	0.423	0.427	0.169	0.067	0.12	0.072	0.119
32	0.422	0.427	0.169	0.067	0.12	0.066	0.12

Production Part Approval Process

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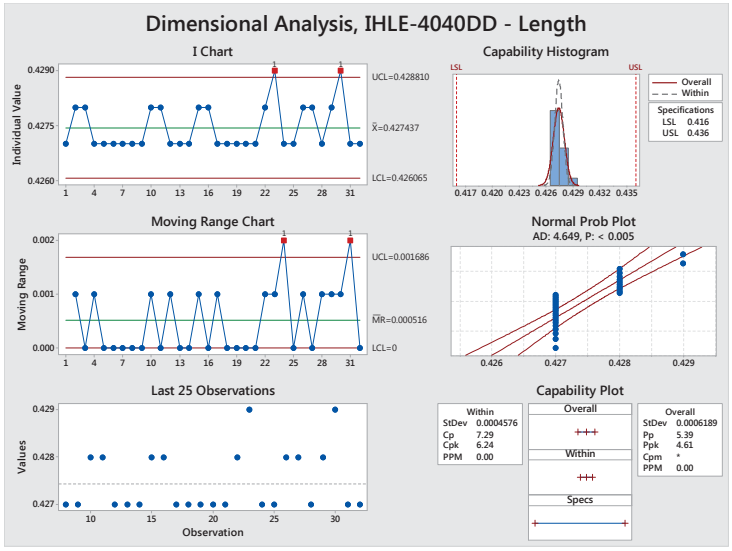
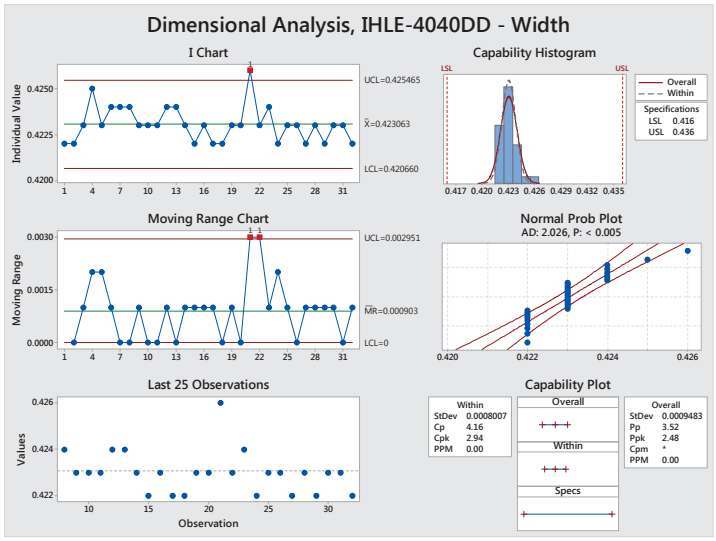
Dimensional Analysis
IHLE-4040DD





Production Part Approval Process

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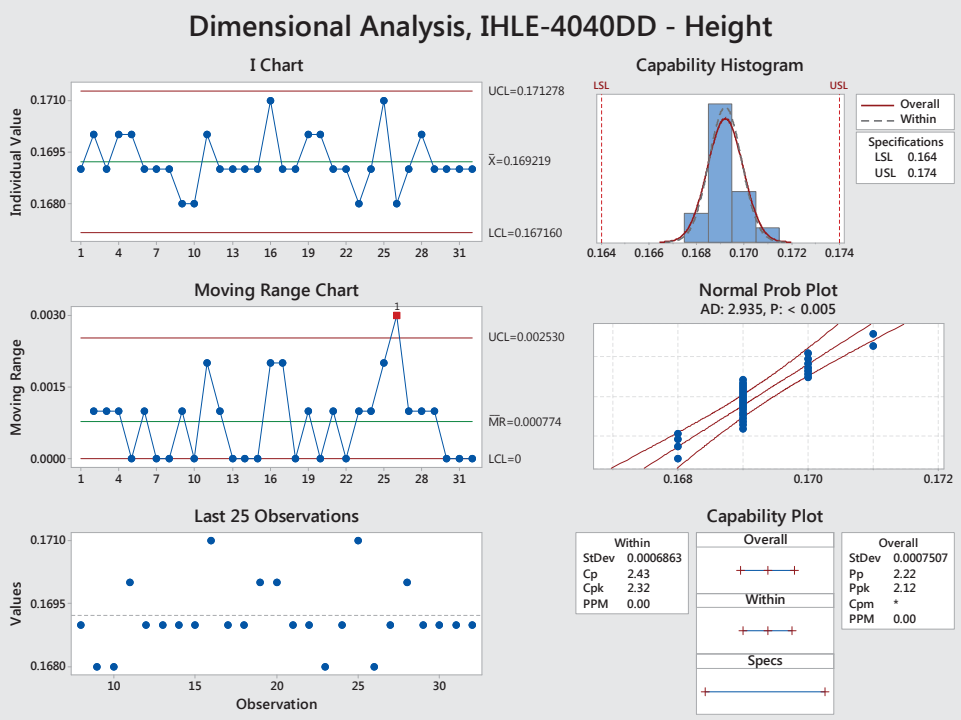
Dimensional Analysis
IHLE-4040DD



Production Part Approval Process

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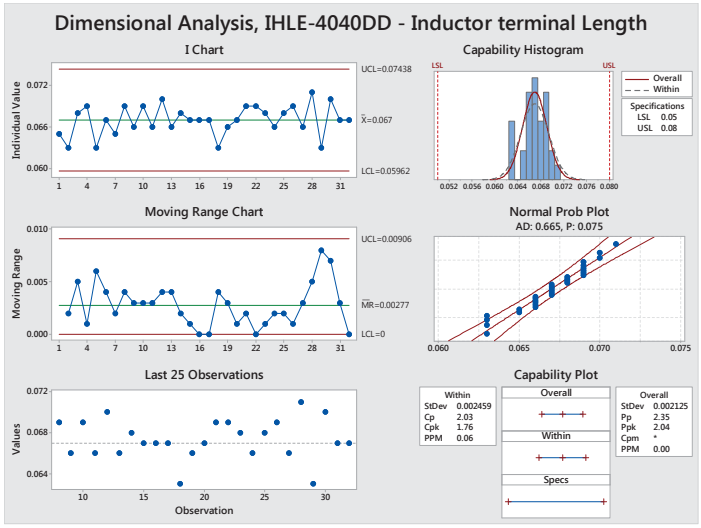
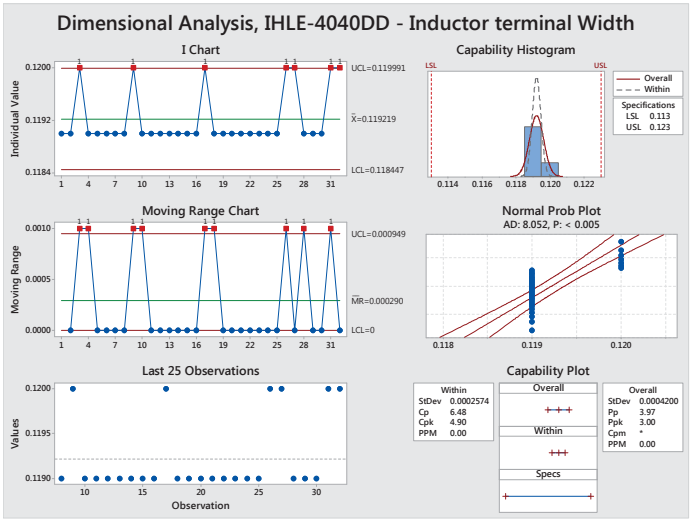
Dimensional Analysis
IHLE-4040DD





Production Part Approval Process

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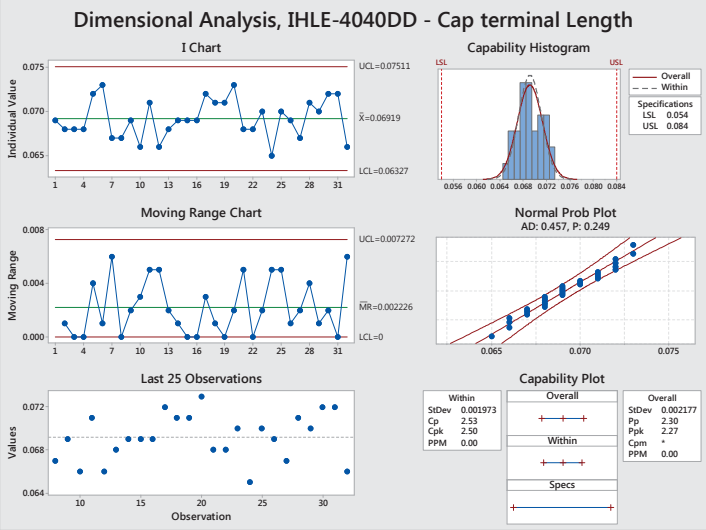
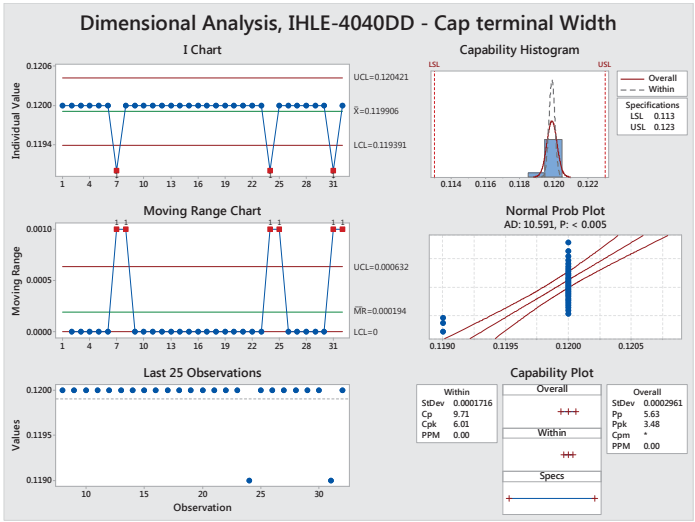
Dimensional Analysis
IHLE-4040DD





SECTION 10

IHLE 4040DD-5A TEST RESULTS

DANSHUI, CHINA MANUFACTURING SITE

IHLE4040DDER150M5A
IHLE4040DDER330M5A

- Parts were produced from the Danshui, China manufacturing site

IHLE4040DDER150M5A

Test #	Description	Ref. Spec. Meth / Cond	Test Conditions	End Point Δ requirements	Sample Size	Meas Temp							
0	3x reflow Preconditioning for lead-free products	ICP 10,373	As specified in sections 6.3 thru 6.4 except Visual per DPS-11,865 10X magnification										
1	Pre- and Post-Stress Electrical Test	IHLP Data Sheet	L (uH) – 100KHz and 250mV DCR – 25°C Ambient	L=±15% of initial, DCR =±15% of initial	All tests requiring electrical data								
3	High Temp Exposure	IEC-60068 Part 2-2 test group BA	155C for 2000 hours, unpowered readings at 0, 250, 500, 1000 and 2000 hour intervals. Initial (0 hr.) and final (2000 hr.) readings at LT/RT/HT LT=Low Temperature=-55°C, RT=Room Temperature=+25°C,HT=High Temperature=+125°C for –A1/1A models. HT=High Temperature =+155° C for -5A models.	L=±20% of initial, DCR =±20% of initial	77			Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
						-55 deg. C	Maximum	15.632	16.321	6.564	32.450	31.310	2.364
							Mimimum	13.912	14.636	3.736	30.030	30.680	-4.746
							Mean	14.745	15.496	5.096	31.345	30.962	-1.207
							Std Dev	0.419	0.450	0.535	0.396	0.146	1.148
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.632	16.437	7.424	45.580	46.230	1.606
							Mimimum	13.912	14.767	4.728	44.920	45.110	-0.132
							Mean	14.745	15.625	5.973	45.293	45.659	0.808
							Std Dev	0.419	0.445	0.498	0.156	0.250	0.405
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.343	16.669	9.969	68.850	62.760	-7.365
							Mimimum	13.753	14.974	7.977	66.510	60.920	-10.749
							Mean	14.558	15.845	8.839	67.472	61.873	-8.295
							Std Dev	0.393	0.440	0.466	0.470	0.379	0.659

IHLE4040DDER150M5A

								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
	Low Temperature Storage	EC-60068 Part 2-1 test group Aa	-55°C for 2000 hours unpowered readings at 0, 250, 500, 1000 and 2000 hour intervals. Initial (0 hr.) and final (2000 hr.) readings at LT/RT/H	L=±20% of initial, DCR =±20% of initial	77	-55 deg. C	Maximum	15.738	15.674	0.410	31.780	32.300	2.441
							Mimimum	13.838	13.829	-0.779	31.090	31.500	0.285
							Mean	14.705	14.675	-0.204	31.373	31.774	1.281
							Std Dev	0.484	0.473	0.238	0.158	0.145	0.418
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.862	15.750	-0.040	45.700	45.740	0.845
							Mimimum	13.956	13.895	-0.994	44.960	44.870	-1.227
							Mean	14.811	14.742	-0.460	45.395	45.340	-0.121
							Std Dev	0.485	0.469	0.203	0.157	0.179	0.350
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.626	15.685	0.401	63.330	64.200	2.638
							Mimimum	13.794	13.847	0.081	61.810	62.900	1.066
							Mean	14.644	14.681	0.256	62.543	63.627	1.735
							Std Dev	0.455	0.459	0.080	0.358	0.308	0.299

IHLE4040DDER150M5A

								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
4	Temperature Cycling	IEC-60068, Part 2.14 test group Na	-55°C to +125°C (+155° C for -5A models) dw ell time = 30 min. transfer time ≤10 sec. no. of cycles = 1000 unpow ered initial (0 cycles) and final 1000 cycles). Readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	77	-55 deg. C	Maximum	15.735	15.792	2.234	32.010	31.700	0.705
							Mimimum	13.713	14.004	0.174	31.110	30.680	-3.219
							Mean	14.851	15.040	1.276	31.483	31.080	-1.278
							Std Dev	0.478	0.455	0.367	0.194	0.223	0.941
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.818	15.873	2.285	46.470	45.220	-0.688
							Mimimum	13.762	14.054	0.119	45.040	44.050	-3.947
							Mean	14.931	15.116	1.246	45.692	44.870	-1.795
							Std Dev	0.474	0.452	0.374	0.307	0.194	0.770
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.556	16.031	4.403	63.430	62.020	0.141
							Mimimum	13.651	14.225	2.931	61.600	59.470	-5.453
							Mean	14.719	15.278	3.803	62.430	61.366	-1.700
							Std Dev	0.453	0.451	0.258	0.389	0.493	1.078

								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
7	Biased Humidity	IEC-60068 Part 2-67	Temperature = 85°C ±20°C Humidity = 85% ±5% RH Duration = 1000 hours Pow er = No Pow er Initial (0hr.) and final (1000hr.) readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	77	-55 deg. C	Maximum	15.497	15.352	-0.302	32.010	31.660	-0.506
							Mimimum	13.831	13.774	-1.532	31.300	30.720	-2.575
							Mean	14.685	14.557	-0.871	31.628	31.249	-1.198
							Std Dev	0.474	0.459	0.233	0.156	0.162	0.443
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.611	15.443	-0.442	46.560	45.590	-0.615
							Mimimum	13.968	13.878	-1.458	45.310	44.180	-3.516
							Mean	14.775	14.637	-0.935	45.982	45.229	-1.635
							Std Dev	0.465	0.454	0.201	0.301	0.223	0.587
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.424	15.370	0.107	63.310	63.530	2.114
							Mimimum	13.877	13.858	-0.937	59.140	60.390	-1.017
							Mean	14.655	14.607	-0.322	62.335	62.348	0.021
							Std Dev	0.450	0.445	0.226	0.515	0.522	0.553

IHLE4040DDER150M5A

								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
8	Operational Life	MIL-STD-202, Method 108A	Temperature = 85°C for -1A/A1 models. Temperature =115° C for -5A models. Duration = 2000hrs. Power = As noted on the test request. Readings a 0, 250, 500, 1000 and 2000 hour intervals. Initial (0 hr.) and final (2000 hr.) readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	77	-55 deg. C	Maximum	15.327	15.770	3.771	32.320	31.740	0.603
							Mimimum	13.432	13.770	1.988	31.120	30.620	-4.332
							Mean	14.682	15.080	2.710	31.627	31.098	-1.670
							Std Dev	0.438	0.454	0.378	0.215	0.230	0.895
								Initial	Final	%Δ	Initial	Final	%Δ
						+25 deg. C	Maximum	15.394	15.933	4.328	46.190	45.530	0.067
							Mimimum	13.534	13.932	2.551	44.810	44.630	-2.277
							Mean	14.767	15.250	3.271	45.403	45.096	-0.674
							Std Dev	0.430	0.452	0.385	0.285	0.193	0.635
								Initial	Final	%Δ	Initial	Final	%Δ
						+155 deg. C	Maximum	15.229	16.136	6.564	63.830	63.090	1.258
							Mimimum	13.368	14.113	4.859	61.100	59.900	-4.313
							Mean	14.599	15.418	5.606	62.432	62.021	-0.655
							Std Dev	0.417	0.447	0.319	0.522	0.500	0.787

9	External Visual	MIL-STD-883G Method 2009.9	Inspect construction and workmanship.	Pass all criteria as defined in DPS-11,865 VA1	All	na	Pass
10	Physical Dimensions	JESD22 Method JB-100	Verify physical dimensions per part specification	All parts within dimensional tolerance per data sheet	30	na	Pass
12	Resistance to Solvents	MIL-STD-202G Method 215K	Add Aqueous wash chemical. OKEM Clean or equivalent. Do not use banned solvents.	Pass all criteria as defined in DPS-11,865 VA1 L=±20% of initial, DCR =±20% of initial	5	na	Pass

IHLE4040DDER150M5A

								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
13	Mechanical Shock	IEC-60068 part 2.27 test group Ea with precondition per 0 above	Pulse Shape-Half Sine Normal Pulse Length 6ms Peak acceleration-100g No. shocks-6 each in both directions of each axis (total of 36) Initial and final readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	30	-55 deg. C	Maximum	15.443	15.324	-0.075	32.080	31.750	0.699
							Mimimum	14.015	13.966	-0.950	31.430	31.000	-2.805
							Mean	14.814	14.729	-0.564	31.706	31.344	-1.135
							Std Dev	0.455	0.434	0.233	0.224	0.206	1.033
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.533	15.390	4.248	45.980	45.400	-0.044
							Mimimum	14.058	14.062	-4.228	45.200	44.740	-2.229
							Mean	14.874	14.809	-0.393	45.694	45.159	-1.170
							Std Dev	0.495	0.418	2.450	0.180	0.143	0.449
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.277	15.305	0.282	62.670	62.520	2.368
							Mimimum	13.952	13.989	0.010	58.710	60.100	-1.594
							Mean	14.703	14.724	0.147	62.058	61.884	-0.274
							Std Dev	0.421	0.423	0.056	0.678	0.493	0.727

								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
14	Vibration	IEC-60068 PART 2-6 TEST GROUP Fc. With precondition per 0 above	Pulse Shape-sine wave range of frequency 1 10-55Hz. Amplitude ±0.75mm Range of frequency 2 55-2000Hz Amplitude; 10G Frequency Sweep: 1 oct./min. Duration: 24 h each of 3 axis. Initial and final readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	30	-55 deg. C	Maximum	15.634	15.528	-0.184	32.040	32.070	0.348
							Mimimum	14.163	14.104	-1.009	31.310	31.360	-0.347
							Mean	15.003	14.925	-0.517	31.671	31.696	0.080
							Std Dev	0.385	0.368	0.175	0.177	0.195	0.177
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.730	15.616	-0.217	45.750	45.620	-0.066
							Mimimum	14.238	14.168	-0.825	45.150	45.050	-0.352
							Mean	15.086	15.003	-0.547	45.441	45.337	-0.229
							Std Dev	0.378	0.362	0.160	0.152	0.142	0.054
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.510	15.508	0.030	62.740	62.640	0.779
							Mimimum	14.095	14.094	-0.124	61.630	61.780	-0.735
							Mean	14.908	14.907	-0.006	62.410	62.289	-0.194
							Std Dev	0.350	0.349	0.034	0.216	0.235	0.304

IHLE4040DDER150M5A

								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
	Bump	IEC-60068 part 2-29 test group Eb with precondition per 0 above.	Pulse shape: half sine Nominal pulse length: 6 ms Peak Acceleration: 40g No. of shocks: 4000 each mechanical axis.Initial and final readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	30	-55 deg. C	Maximum	15.677	15.545	-0.229	31.890	31.940	0.571
							Mimimum	14.005	13.917	-1.080	31.220	31.080	-2.018
							Mean	14.708	14.607	-0.686	31.633	31.357	-0.873
							Std Dev	0.454	0.437	0.169	0.152	0.259	0.758
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.765	15.628	-0.298	45.670	45.430	-0.088
							Mimimum	14.098	14.011	-1.073	44.900	44.820	-1.234
							Mean	14.793	14.689	-0.697	45.355	45.149	-0.453
							Std Dev	0.454	0.435	0.181	0.179	0.163	0.372
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	15.486	15.509	0.217	63.370	62.330	-0.209
							Mimimum	13.894	13.917	0.073	62.070	61.180	-2.843
							Mean	14.572	14.595	0.160	62.739	61.868	-1.384
							Std Dev	0.422	0.425	0.037	0.367	0.297	0.824
								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
15	Resistance to Solder Heat	MIL-STD-202G Method 210F Condition K	IR/convection reflow. 250 ± 5°C for 30 ± 5sec. Ramp rate 1°C/s to 4°C/; Above 183°C for 90s-120s	L=±20% of initial, DCR =±20% of initial	30	+25 deg. C	Maximum	15.523	15.658	2.130	46.220	46.050	0.109
							Mimimum	13.702	13.943	0.044	45.770	45.560	-0.480
							Mean	14.671	14.822	1.041	45.974	45.872	-0.221
							Std Dev	0.508	0.475	0.543	0.102	0.112	0.150
								Inductance (µH)			DC Resistance (mΩ)		
								Initial	25KV	%Δ	Initial	25KV	%Δ
17	ESD	AEC-Q200-002	Determine the Classification of the part.	L=±20% of initial, DCR =±20% of initial	15	+25 deg. C	Maximum	15.402	15.417	0.839	46.020	45.600	-0.852
							Mimimum	13.568	13.618	-0.574	45.660	45.220	-0.981
							Mean	14.432	14.461	0.191	45.879	45.449	-0.937
							Std Dev	0.493	0.512	0.451	0.101	0.103	0.038
18	Solderability	J-STD-002C Method B1	4 hours @ 155°C dry heat @ 255°C. 90° dipping angle.	95% or greater coverage on "A" (seating plane) per J-STD-002C	15	NA	Pass						

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								Inductance (µH)			DC Resistance (mΩ)		
19	Electrical Characterization	User Specification	Min, Max, Mean, and Standard Deviation @ Min (-55C), Room, and Max (+125C) operating temperatures. After mounted, allow +/-5% shift DCR at room temp. -55C/+125C DCR Max calculated using temp conversion for copper: $R_2 = [(T_2 + 234.5) / (234.5 + T_A)] * 1.05R_A$ (A = Ambient, 2 = new con)	Final Test: L=±20% of initial, DCR per calculated limits described in test conditions. L test for -55C & +125C = ±20% initial	30			Initial	[redacted]		Initial	[redacted]	
					-55 deg. C	Maximum	15.677			31.890		
						Mimimum	14.005			31.220		
						Mean	14.708			31.633		
						Std Dev	0.454			0.152		
					+25 deg. C		Initial			Initial		
						Maximum	15.765			45.670		
						Mimimum	14.098			44.900		
						Mean	14.793			45.355		
						Std Dev	0.454			0.179		
					+155 deg. C		Initial			Initial		
						Maximum	15.486			63.370		
						Mimimum	13.894			62.070		
						Mean	14.572			62.739		
						Std Dev	0.422			0.367		
							Inductance (µH)			DC Resistance (mΩ)		
							Initial	Final	%Δ	Initial	Final	%Δ
21	Board Flex	AEC-Q200-005 Appendix 2	2mm minimum flex for 60 (+5) sec	Pass all criteria as defined in DPS-11,865 VA1 L=±20% of initial, DCR =±20% of initial	30	+25 deg. C	Maximum	15.301	15.378	1.869	46.280	46.480	0.914
							Mimimum	13.318	13.392	-1.295	45.700	45.840	-0.562
							Mean	14.388	14.460	0.496	45.969	46.091	0.267
							Std Dev	0.491	0.509	0.424	0.145	0.174	0.357
								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
22	Terminal Strength	AEC-Q200-006 Appendix 1	Force of 1.8kg (17.7 N) for 60 seconds	Pass all criteria as defined in DPS-11,865 VA1 L=±20% of initial, DCR =±20% of initial	30	+25 deg. C	Maximum	15.445	15.311	-0.770	46.000	46.150	0.547
							Mimimum	12.732	12.617	-1.335	45.570	45.580	0.022
							Mean	14.336	14.201	-0.939	45.787	45.899	0.245
							Std Dev	0.665	0.663	0.123	0.121	0.129	0.131

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Test #	Description	Ref. Spec. Meth / Cond	Test Conditions	End Point Δ requirements	Sample Size	Meas Temp		Inductance (µH)			DC Resistance (mΩ)		
0	Preconditioning for lead-free products	AEC-Q200 Rev C - Pb Free Specific Tests Table 4.2	As specified in sections 4.3.1 thru 4.3.3 except Visual per DPS-11,865 10X magnification										
1	Pre- and Post-Stress Electrical Test	IHLP Data Sheet	L (uH) – 100KHz and 250mV DCR – 25°C Ambient	L=±15% of initial, DCR =±15% of initial	All tests requiring electrical data								
3	High Temp Exposure	IEC-60068 Part 2-2 test group BA	155C for 2000 hours, unpowered readings at 0, 250, 500, 1000 and 2000 hour intervals. Initial (0 hr.) and final (2000 hr.) readings at LT/RT/HT LT=Low Temperature=-55°C, RT=Room Temperature=+25°C,HT=High Temperature=+125°C for –A1/1A models. HT=High Temperature =+155° C for -5A models.	L=±20% of initial, DCR =±20% of initial	77			Initial	Final	%Δ	Initial	Final	%Δ
						-55 deg. C	Maximum	32.759	34.371	7.292	69.390	68.610	0.323
							Mimimum	28.726	30.618	4.514	67.560	66.710	-1.862
							Mean	30.603	32.448	6.043	68.287	67.559	-1.064
							Std Dev	0.886	0.807	0.546	0.468	0.498	0.514
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.016	34.650	7.410	100.480	98.060	-0.728
							Mimimum	28.967	30.859	4.404	97.420	95.950	-2.669
							Mean	30.835	32.694	6.045	98.809	96.959	-1.871
							Std Dev	0.912	0.818	0.615	0.778	0.611	0.428
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	32.976	35.837	11.313	147.890	146.930	0.418
							Mimimum	28.845	31.717	8.183	143.650	142.220	-1.768
							Mean	30.677	33.658	9.732	145.557	144.542	-0.697
							Std Dev	0.933	0.904	0.603	1.122	1.212	0.362

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								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
	Low Temperature Storage	EC-60068 Part 2-1 test group Aa	-55°C for 2000 hours unpowered readings at 0, 250, 500, 1000 and 2000 hour intervals. Initial (0 hr.) and final (2000 hr.) readings at LT/RT/H	L=±20% of initial, DCR =±20% of initial	77	-55 deg. C	Maximum	33.469	33.581	0.505	69.120	68.470	-0.335
							Mimimum	28.884	28.996	0.251	67.280	66.480	-2.679
							Mean	30.890	31.014	0.403	68.152	67.469	-1.000
							Std Dev	1.016	1.013	0.053	0.435	0.415	0.507
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.696	33.970	1.053	99.120	100.890	2.048
							Mimimum	28.936	29.188	0.700	97.320	95.760	-3.302
							Mean	30.992	31.267	0.891	98.138	99.044	0.923
							Std Dev	1.054	1.051	0.078	0.506	0.861	0.730
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.812	33.856	0.239	148.850	148.750	0.153
							Mimimum	28.811	28.875	-0.001	143.740	138.840	-3.670
							Mean	31.063	31.104	0.132	145.875	144.916	-0.658
							Std Dev	1.083	1.080	0.071	1.127	1.664	0.778

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								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
4	Temperature Cycling	IEC-60068, Part 2.14 test group Na	-55°C to +125°C (+155° C for -5A models) dw ell time = 30 min. transfer time ≤10 sec. no. of cycles = 1000 unpow ered initial (0 cycles) and final 1000 cycles). Readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	77	-55 deg. C	Maximum	33.091	33.616	3.436	69.410	68.510	0.074
							Mimimum	28.696	29.639	1.373	67.310	66.230	-2.577
							Mean	30.501	31.204	2.316	68.182	67.043	-1.670
							Std Dev	0.936	0.851	0.408	0.477	0.514	0.540
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.314	33.781	3.522	99.540	99.640	0.488
							Mimimum	28.876	29.829	1.187	96.640	96.230	-1.500
							Mean	30.724	31.415	2.263	97.792	97.605	-0.191
							Std Dev	0.972	0.870	0.471	0.615	0.743	0.496
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.197	34.560	6.129	148.710	147.530	0.356
							Mimimum	28.715	30.308	3.961	143.290	139.110	-4.654
							Mean	30.562	32.010	4.747	145.444	144.314	-0.776
							Std Dev	0.970	0.928	0.418	1.060	1.305	0.661

								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
7	Biased Humidity	IEC-60068 Part 2-67	emperature = 85°C ±20°C Humidity = 85% ±5% RH Duration = 1000 hours Pow er = No Pow er Initial (0hr.) and final (1000hr.) readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	77	-55 deg. C	Maximum	32.840	32.593	-0.510	71.400	69.820	3.637
							Mimimum	29.050	28.646	-2.720	61.870	64.120	-2.213
							Mean	30.676	30.274	-1.314	68.047	68.215	0.256
							Std Dev	0.930	0.979	0.422	1.019	0.724	0.788
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.088	32.875	-0.516	99.220	100.810	2.865
							Mimimum	29.168	28.763	-2.161	96.530	95.130	-2.311
							Mean	30.892	30.490	-1.308	97.703	99.014	1.342
							Std Dev	0.942	1.000	0.429	0.609	0.841	0.752
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.031	32.639	-0.867	147.850	147.800	1.793
							Mimimum	29.039	28.609	-2.401	142.340	143.470	-1.123
							Mean	30.761	30.273	-1.591	145.578	145.294	-0.194
							Std Dev	0.967	0.995	0.377	1.035	1.030	0.618

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								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
8	Operational Life	MIL-STD-202, Method 108A	Temperature = 85°C for -1A/A1 models. Temperature =115° C for -5A models. Duration = 2000hrs. Power = As noted on the test request. Readings a 0, 250, 500, 1000 and 2000 hour intervals. Initial (0 hr.) and final (2000 hr.) readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	77	-55 deg. C	Maximum	32.938	33.375	3.861	69.970	68.870	1.445
							Mimimum	28.665	29.515	1.270	67.110	66.160	-3.929
							Mean	30.572	31.344	2.539	68.401	67.190	-1.766
							Std Dev	0.953	0.844	0.609	0.604	0.609	0.805
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.222	33.926	4.307	100.850	100.410	2.673
							Mimimum	28.893	29.898	1.955	95.780	96.910	-1.881
							Mean	30.805	31.790	3.208	98.155	98.647	0.510
							Std Dev	0.972	0.885	0.521	1.070	0.808	1.138
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.085	34.757	6.866	148.710	148.810	0.746
							Mimimum	28.803	30.434	4.486	142.790	139.780	-3.092
							Mean	30.718	32.462	5.685	145.790	144.242	-1.063
							Std Dev	0.987	0.970	0.524	1.128	1.699	0.701

9	External Visual	MIL-STD-883G Method 2009.9	Inspect construction and workmanship.	Pass all criteria as defined in DPS-11,865 VA1	All	na	Pass
10	Physical Dimensions	JESD22 Method JB-100	Verify physical dimensions per part specification	All parts within dimensional tolerance per data sheet	30	na	Pass
12	Resistance to Solvents	MIL-STD-202G Method 215K	Add Aqueous wash chemical. OKEM Clean or equivalent. Do not use banned solvents.	Pass all criteria as defined in DPS-11,865 VA1 L=±20% of initial, DCR =±20% of initial	5	na	Pass

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								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
13	Mechanical Shock	IEC-60068 part 2.27 test group Ea with precondition per 0 above	Pulse Shape-Half Sine Normal Pulse Length 6ms Peak acceleration-100g No. shocks-6 each in both directions of each axis (total of 36) Initial and final readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	30	-55 deg. C	Maximum	32.515	32.602	0.427	68.840	69.080	1.666
							Mimimum	29.355	29.463	0.135	66.880	67.630	-0.232
							Mean	31.141	31.230	0.287	67.889	68.358	0.692
							Std Dev	0.775	0.763	0.073	0.502	0.444	0.626
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	32.924	33.004	0.382	99.010	98.850	0.459
							Mimimum	29.652	29.748	0.131	96.580	96.880	-0.513
							Mean	31.416	31.505	0.285	97.904	97.823	-0.082
							Std Dev	0.801	0.791	0.057	0.624	0.631	0.431
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	32.950	32.953	0.044	147.160	148.590	1.819
							Mimimum	29.625	29.632	-0.020	142.940	144.540	-0.636
							Mean	31.380	31.384	0.014	145.417	146.510	0.753
							Std Dev	0.808	0.807	0.019	0.946	1.228	0.726

								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
14	Vibration	IEC-60068 PART 2-6 TEST GROUP Fc. With precondition per 0 above	Pulse Shape-sine wave range of frequency 1 10-55Hz. Amplitude ±0.75mm Range of frequency 2 55-2000Hz Amplitude; 10G Frequency Sweep: 1 oct./min. Duration: 24 h each of 3 axis. Initial and final readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	30	-55 deg. C	Maximum	32.346	32.391	0.363	68.350	68.890	2.063
							Mimimum	29.530	29.619	0.077	66.410	67.570	0.395
							Mean	30.862	30.937	0.243	67.659	68.278	0.917
							Std Dev	0.729	0.717	0.082	0.445	0.349	0.371
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	32.648	32.672	0.373	98.980	98.750	3.244
							Mimimum	29.779	29.861	0.074	94.020	96.800	-0.654
							Mean	31.135	31.216	0.262	97.613	97.733	0.132
							Std Dev	0.754	0.744	0.071	1.129	0.541	0.934
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	32.620	32.638	0.064	147.970	148.000	3.455
							Mimimum	29.705	29.712	-0.072	142.410	144.070	-0.255
							Mean	31.068	31.077	0.030	145.480	146.036	0.388
							Std Dev	0.753	0.753	0.025	1.340	1.049	0.940

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								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
	Bump	IEC-60068 part 2-29 test group Eb with precondition per 0 above.	Pulse shape: half sine Nominal pulse length: 6 ms Peak Acceleration: 40g No. of shocks: 4000 each mechanical axis.Initial and final readings at LT/RT/HT	L=±20% of initial, DCR =±20% of initial	30	-55 deg. C	Maximum	33.206	33.287	0.437	68.740	69.390	1.337
							Mimimum	29.830	29.938	0.152	67.430	67.170	-1.041
							Mean	31.278	31.371	0.299	68.086	68.084	-0.003
							Std Dev	0.927	0.913	0.069	0.313	0.631	0.843
						+25 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.456	33.558	0.429	98.800	98.780	0.275
							Mimimum	30.111	30.228	0.174	96.760	96.740	-0.801
							Mean	31.566	31.664	0.313	97.863	97.692	-0.173
							Std Dev	0.959	0.951	0.058	0.506	0.530	0.483
						+155 deg. C		Initial	Final	%Δ	Initial	Final	%Δ
							Maximum	33.413	33.488	0.255	147.850	146.450	0.646
							Mimimum	30.055	30.112	0.174	144.010	143.130	-1.892
							Mean	31.516	31.580	0.204	146.122	144.759	-0.930
							Std Dev	0.976	0.976	0.021	0.991	0.783	0.705
								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
15	Resistance to Solder Heat	MIL-STD-202G Method 210F Condition K	IR/convection reflow. 250 ± 5°C for 30 ± 5sec. Ramp rate 1°C/s to 4°C/; Above 183°C for 90s-120s	L=±20% of initial, DCR =±20% of initial	30	+25 deg. C	Maximum	32.930	32.970	0.945	99.460	99.170	-0.153
							Mimimum	28.539	28.809	0.007	97.810	97.460	-0.494
							Mean	30.998	31.163	0.538	98.846	98.538	-0.312
							Std Dev	1.022	0.974	0.234	0.527	0.503	0.080
								Inductance (µH)			DC Resistance (mΩ)		
								Initial	25KV	%Δ	Initial	25KV	%Δ
17	ESD	AEC-Q200-002	Determine the Classification of the part.	L=±20% of initial, DCR =±20% of initial	15	+25 deg. C	Maximum	32.438	32.701	1.137	100.110	99.790	-0.223
							Mimimum	29.215	29.499	-0.128	98.520	97.810	-0.779
							Mean	30.423	30.662	0.787	99.269	98.813	-0.460
							Std Dev	0.862	0.864	0.302	0.590	0.680	0.201
18	Solderability	J-STD-002C Method B1	4 hours @ 155°C dry heat @ 255°C. 90° dipping angle.	95% or greater coverage on "A" (seating plane) per J-STD-002C	15	NA	Pass						

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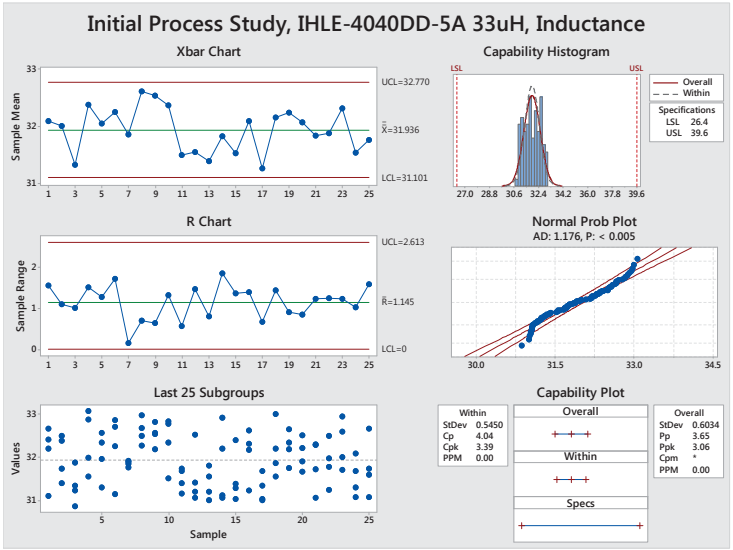
								Inductance (µH)			DC Resistance (mΩ)		
19	Electrical Characterization	User Specification	Min, Max, Mean, and Standard Deviation @ Min (-55C), Room, and Max (+125C) operating temperatures. After mounted, allow +/-5% shift DCR at room temp. -55C/+125C DCR Max calculated using temp conversion for copper: $R_2 = [(T_2 + 234.5) / (234.5 + T_A)] * 1.05R_A$ (A = Ambient, 2 = new con)	Final Test: L=±20% of initial, DCR per calculated limits described in test conditions. L test for -55C & +125C = ±20% initial	30			Initial	[redacted]		Initial	[redacted]	
					-55 deg. C	Maximum	33.206			68.740		
						Mimimum	29.830			67.430		
						Mean	31.278			68.086		
						Std Dev	0.927			0.313		
					+25 deg. C		Initial			Initial		
						Maximum	33.456			98.800		
						Mimimum	30.111			96.760		
						Mean	31.566			97.863		
						Std Dev	0.959			0.506		
					+155 deg. C		Initial			Initial		
						Maximum	33.413			147.850		
						Mimimum	30.055			144.010		
						Mean	31.516			146.122		
						Std Dev	0.976			0.991		
							Inductance (µH)			DC Resistance (mΩ)		
							Initial	Final	%Δ	Initial	Final	%Δ
21	Board Flex	AEC-Q200-005 Appendix 2	2mm minimum flex for 60 (+5) sec	Pass all criteria as defined in DPS-11,865 VA1 L=±20% of initial, DCR =±20% of initial	30	+25 deg. C	Maximum	33.780	33.975	0.766	100.320	101.750	2.040
							Mimimum	29.145	29.338	-0.280	98.450	99.910	1.017
							Mean	30.948	31.114	0.535	99.139	100.834	1.710
							Std Dev	1.084	1.095	0.216	0.504	0.495	0.258
								Inductance (µH)			DC Resistance (mΩ)		
								Initial	Final	%Δ	Initial	Final	%Δ
22	Terminal Strength	AEC-Q200-006 Appendix 1	Force of 1.8kg (17.7 N) for 60 seconds	Pass all criteria as defined in DPS-11,865 VA1 L=±20% of initial, DCR =±20% of initial	30	+25 deg. C	Maximum	32.712	32.742	0.190	99.460	99.940	0.543
							Mimimum	29.451	29.447	-0.157	97.820	98.060	0.030
							Mean	30.838	30.837	-0.004	98.699	99.015	0.320
							Std Dev	0.900	0.905	0.073	0.551	0.601	0.148

Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

Initial Process Study
IHLE4040DDER330M5A, Inductance measurement

Inductance (uH)							
1	31.100	26	31.767	51	31.813	76	32.182
2	32.420	27	31.849	52	31.006	77	31.906
3	32.660	28	31.915	53	32.914	78	32.509
4	32.200	29	32.503	54	32.195	79	31.661
5	32.390	30	32.676	55	31.123	80	32.216
6	32.500	31	32.268	56	31.057	81	31.063
7	31.400	32	32.974	57	32.401	82	32.294
8	31.740	33	32.566	58	31.039	83	31.720
9	31.230	34	32.193	59	31.283	84	32.286
10	30.870	35	32.828	60	31.388	85	31.974
11	31.880	36	32.535	61	32.626	86	32.496
12	31.340	37	32.346	62	31.231	87	31.247
13	31.560	38	32.781	63	32.317	88	31.775
14	31.990	39	32.837	64	32.167	89	32.591
15	33.070	40	31.517	65	31.012	90	32.000
16	32.880	41	31.161	66	31.035	91	32.949
17	32.340	42	31.734	67	31.341	92	31.714
18	32.570	43	31.401	68	31.681	93	31.302
19	31.960	44	31.680	69	31.556	94	31.683
20	31.300	45	31.420	70	31.858	95	32.091
21	32.259	46	32.525	71	32.203	96	31.072
22	32.709	47	31.059	72	32.999	97	32.663
23	31.148	48	31.209	73	32.348	98	31.075
24	32.871	49	31.198	74	32.655	99	31.595
25	31.890	50	31.548	75	31.749	100	31.733

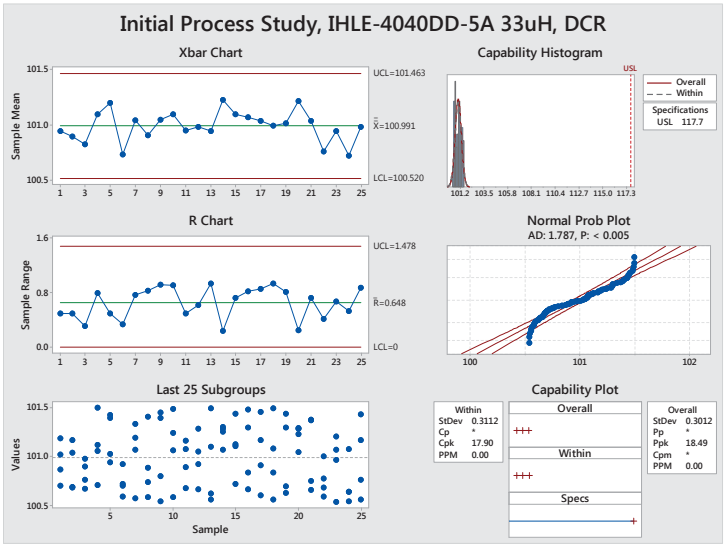


Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

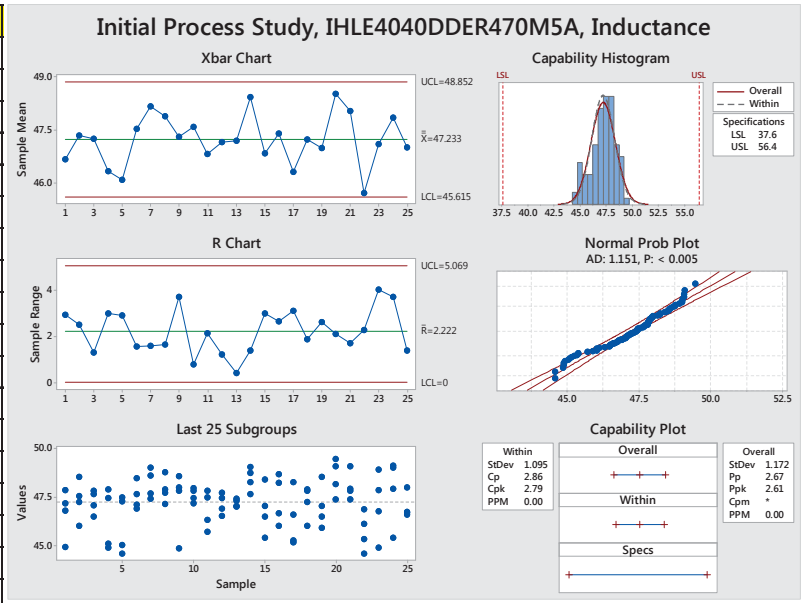
Initial Process Study
IHLE4040DDER330M5A, DCR measurement

DC Resistance (mOhm)							
1	100.700	26	100.571	51	101.102	76	101.441
2	100.870	27	101.197	52	100.624	77	101.286
3	101.020	28	101.337	53	101.254	78	101.234
4	101.190	29	101.411	54	101.302	79	101.049
5	101.040	30	100.741	55	101.069	80	101.294
6	101.170	31	100.886	56	101.287	81	100.748
7	100.690	32	100.585	57	101.442	82	101.370
8	100.680	33	101.395	58	100.720	83	101.381
9	100.670	34	100.803	59	101.125	84	100.659
10	100.980	35	100.541	60	101.106	85	100.591
11	100.760	36	101.453	61	100.666	86	101.005
12	100.900	37	101.489	62	100.838	87	100.683
13	100.710	38	100.584	63	101.482	88	100.773
14	101.120	39	101.066	64	101.300	89	101.068
15	101.060	40	101.241	65	101.461	90	100.968
16	101.500	41	100.890	66	100.914	91	101.206
17	101.400	42	100.675	67	100.604	92	100.537
18	101.430	43	101.076	68	101.169	93	100.543
19	101.030	44	101.164	69	100.839	94	100.637
20	100.940	45	101.288	70	101.499	95	100.640
21	100.700	46	100.924	71	100.562	96	101.076
22	100.719	47	100.667	72	101.084	97	101.434
23	100.925	48	101.053	73	100.697	98	100.765
24	100.592	49	100.559	74	101.300	99	100.558
25	101.068	50	101.495	75	100.628	100	101.168



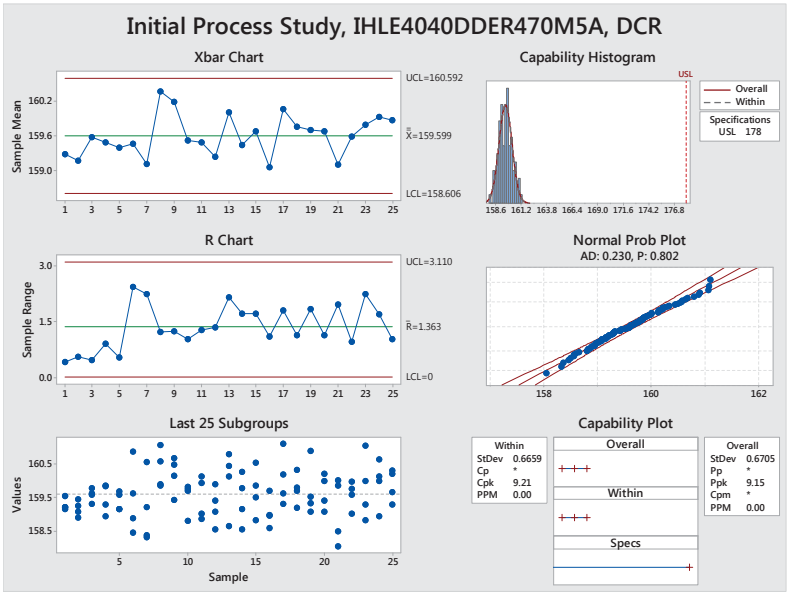
INITIAL PROCESS STUDY, IHLE4040DDER470M5A

Inductance (uH)							
1	47.859	26	49.006	51	47.001	76	45.903
2	47.156	27	48.602	52	47.042	77	47.363
3	44.917	28	47.685	53	47.649	78	49.462
4	46.787	29	47.727	54	49.029	79	49.081
5	47.228	30	47.133	55	48.750	80	48.156
6	46.028	31	47.901	56	48.252	81	47.361
7	48.538	32	48.779	57	48.403	82	49.074
8	47.560	33	44.864	58	47.051	83	47.909
9	46.499	34	47.815	59	45.396	84	47.819
10	47.649	35	47.991	60	46.477	85	45.343
11	47.081	36	48.570	61	46.026	86	44.574
12	47.808	37	47.952	62	48.229	87	46.849
13	47.450	38	47.440	63	48.677	88	46.119
14	47.880	39	47.158	64	46.659	89	48.909
15	45.098	40	47.832	65	46.578	90	46.772
16	44.889	41	47.832	66	45.252	91	44.890
17	47.288	42	46.310	67	45.160	92	47.855
18	45.046	43	47.466	68	48.255	93	49.100
19	44.586	44	45.701	69	46.023	94	49.013
20	47.490	45	47.460	70	47.231	95	45.390
21	47.097	46	46.520	71	47.811	96	47.934
22	46.904	47	47.730	72	47.887	97	46.739
23	47.661	48	46.914	73	48.527	98	46.690
24	48.469	49	47.317	74	47.040	99	47.994
25	47.414	50	47.424	75	46.499	100	46.607



INITIAL PROCESS STUDY, IHLE4040DDER470M5A

DC Resistance (mOhm)							
1	159.557	26	159.221	51	160.140	76	160.905
2	159.209	27	158.325	52	160.796	77	160.211
3	159.150	28	158.366	53	160.266	78	159.421
4	159.223	29	160.585	54	159.791	79	159.084
5	159.451	30	159.864	55	158.555	80	160.007
6	158.897	31	159.906	56	159.158	81	158.049
7	159.259	32	161.081	57	159.515	82	158.494
8	159.086	33	160.146	58	158.823	83	160.011
9	159.597	34	160.492	59	160.540	84	159.857
10	159.779	35	160.679	60	159.854	85	159.023
11	159.630	36	159.437	61	159.696	86	159.975
12	159.314	37	159.824	62	158.989	87	159.589
13	159.853	38	159.709	63	158.594	88	159.765
14	159.843	39	159.759	64	158.956	89	158.818
15	158.948	40	158.805	65	160.186	90	161.062
16	159.290	41	158.859	66	159.307	91	159.295
17	159.594	42	160.137	67	161.107	92	159.999
18	159.680	43	159.022	68	159.623	93	160.641
19	159.158	44	159.947	69	159.204	94	160.131
20	159.150	45	159.894	70	159.796	95	159.993
21	158.455	46	158.554	71	159.704	96	158.946
22	160.884	47	159.080	72	160.334	97	160.219
23	158.888	48	159.416	73	159.328	98	159.665
24	159.621	49	160.449	74	159.520	99	160.317
25	160.569	50	158.650	75	159.070	100	159.285



Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

Use the control buttons below to navigate through the PPAP sections.

Section 12: Qualified Laboratories

Vishay / Dale Electronics
1505 East Hway 50 Yankton, SD 57078, USA Phone (605) 665-9301 Fax (605) 668-4247
ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS

Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

Use the control buttons below to navigate through the PPAP sections.

Section 13: Appearance Approval Report

Inductors, like many other electronic components are specified for their electrical properties. There are no specific requirements stated for the physical appearance of inductors, e.g. color of inductors. Therefore, the Appearance Approval Report does not apply in this case.

Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

Use the control buttons below to navigate through the PPAP sections.

Section 14: Sample Product

Sample product from the Vishay Manufacturing Facility is available upon request

Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

Use the control buttons below to navigate through the PPAP sections.

Section 15: Master Sample

Master Sample(s) will be retained at the Vishay Manufacturing Facility with a copy of the PPAP

Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

Use the control buttons below to navigate through the PPAP sections.

Section 16: Checking Aids

Checking Aids are not required for this electronic component

Vishay / Dale Electronics
1505 East Hway 50 Yankton, SD 57078, USA Phone (605) 665-9301 Fax (605) 668-4247

Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

Use the control buttons below to navigate through the PPAP sections.

Section 17: Records of Compliance

Moisture Sensitivity Level: 1

Production Part Approval Process

The following PPAP documentation is assembled according to AIAG, 4th Edition PPAP Manual and applicable customer requirements

Use the control buttons below to navigate through the PPAP sections.

Section 19: Bulk Material Requirements

Bulk Material Requirements do not apply to this Electronic Component.

IHLP Standards of Manufacture

IHLP INTRODUCTION SURFACE IRREGULARITIES CRITERIA FOR REJECTION SUMMARY

INTRODUCTION

Scope

This document was written for the purpose of helping customers better understand the product they are purchasing. It will give the customer an idea as to the type of cosmetic irregularities that may occur from time to time during the manufacture of the component itself or during customer use of the component.

This document also discusses the criteria that have been developed for rejection of irregularities that are determined to be excessive.

While it would be desirable to have cosmetically perfect IHLP inductors, the powdered iron manufacturing technique has cosmetic limitations.

Certified test labs have performed extensive environmental testing on IHLP's with and without cosmetic imperfections according to AEC-Q200 standards for such tests as thermal shock, mechanical shock, vibration, humidity and others. This testing has shown that the cosmetic imperfections listed in this document do not affect the performance or reliability of the IHLP inductor. Test results are available upon request.

Product

The IHLP inductor is unique from most inductors. The inductor body is a soft magnetic composite (SMC), not a ferrite. It is made from an iron powder mixture and cemented together using a resin binder. This powder mixture, when pressed around the inductor coil, greatly enhances the electrical properties of the inductor and gives protection from environmental forces. After pressing, the component is cured in an oven to increase the bonding strength of the resin binders with the iron powder, yielding excellent electrical and physical properties.

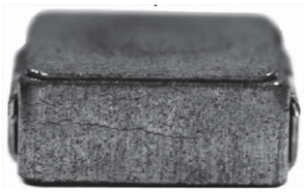
The IHLP inductor provides the best combination of:

- Inductance
- Low Core Loss
- Saturation
- Temperature Stability
- Smallest Footprint
- Lowest Profile

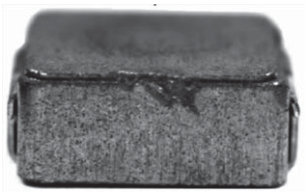
Surface irregularities

The following pages include descriptions of the most common irregularities seen on IHLP inductors. Common causes are described along with variations in their magnitude. Customers may at some time see one or all of these irregularities.

Those that are determined to adversely affect the customer's use of the component are rejected, but minor (acceptable) irregularities will occasionally be present. With the use of this guide, a customer will better understand the effect of each irregularity.



Cracks



Chips

Oxidation

APPLICATION NOTE

IHLP Standards of Manufacture

CRACKS

Cracks within the inductor body are unavoidable during the manufacturing process. Small cracks are caused by die wall friction when the parts are ejected during the pressing process and by expansion of the coil during the process of curing the resin binder in the powdered iron body. Unlike ferrite material, cracks on the IHLP body do not affect the electrical performance of the component.

Reliability testing has shown that even cracks in excess of 0.005" will not cause the component to fail electrically or physically in field application. Acceptance widths are adopted based on the ability to detect cracks both at the component and circuit level.

Terminal area crack, acceptable

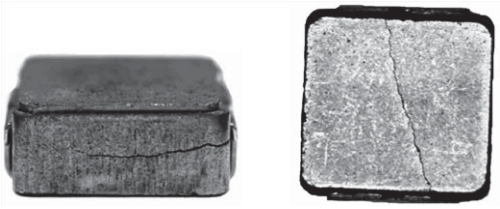
Cracks coming from the top corner of the terminal are a normal occurrence and are caused by terminal expansion during curing operations.

Negligible crack, acceptable

Negligible cracks are those that are nearly invisible without magnification.

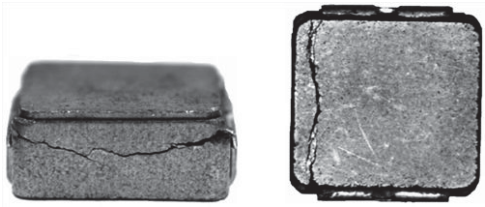
Minor crack, acceptable

Minor cracks are those that are visible without magnification but are not apparent without close inspection.



Moderate crack, rejectable

Moderate cracks are those that are obvious upon examination and continue across most of the component.



Major crack, rejectable

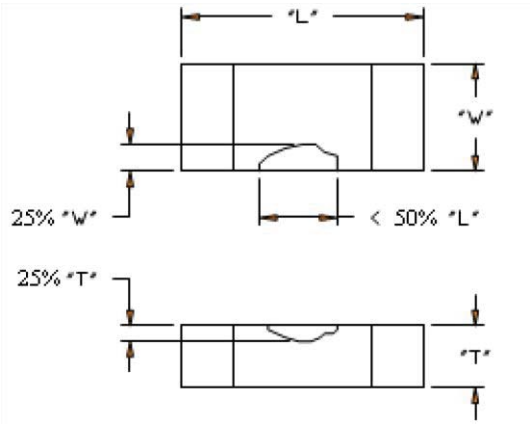
Major cracks are those that are obvious to a customer and would possibly result in large chip-outs that would expose the coil and lead frame.

APPLICATION NOTE

IHLP Standards of Manufacture

CHIPS

Chipping of the inductor body can occur during normal processing and testing of the inductor. The acceptance criteria for chipping vary with the size of the component, but current acceptance standards are based on IPCA-610. The effect of chipping is negligible as long as the inductor coil is not showing. See IPC standard for class 1 and 2 components below.



T	25 % of the thickness
W	25 % of the width
L	50 % of the length

Chips typically occur on the edges and corners of the inductor body. They are slightly darker in color and rougher in appearance than the surrounding material.

Minor chipping, acceptable

Minor chips in the inductor body are those that are typically shallow imperfections that occur on the corners and edge of components. No coil wire or lead frame is showing and the chip does not affect the performance or reliability of the component.

Major chipping, rejectable

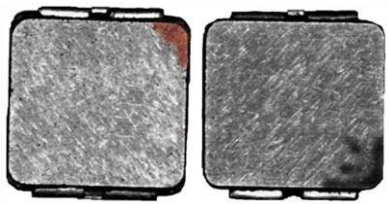
Major chips in the inductor body are those that are very obvious to the customer and may expose the wire coil or lead frame.

OXIDATION

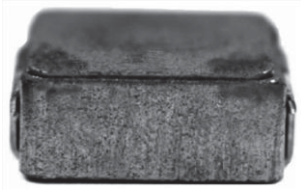
The IHLP inductor is predominately iron and oxidation may occur in a small percentage of the inductors. Resin binders give moderate protection, but some slight oxidation may occur. All components should be stored away from heat, humidity and ionized atmospheres as much as possible before mounting.

Basic steps should be taken in order to limit surface oxidation, including keeping the IHLP inductors sealed in their packaging until PCB mounting.

In the case that oxidation does occur, the effects are contained to the surface of the component and do not penetrate into the core material. No electrical effects have ever been documented due to oxidation of the IHLP product. Oxidation should never be considered a reliability risk.



Top view



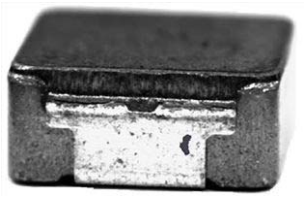
Side view

IHLP Standards of Manufacture

OTHER

A very small number of other irregularities have been reported. These occur at an exceedingly low rate and typically do not affect the components electrically. These include:

Foreign material may be seen pressed into the upper terminals. This material is of the same material as the inductor body and should not be a reason for rejection unless solderability is affected.



Foreign material: Acceptable

Scratches may be seen on the surface of the inductor body. Scratches are an acceptable surface irregularity.

Scratch: Acceptable

SUMMARY

The IHLP inductor is comprised of an iron powder body compressed around a coil. Due to the fact that this iron powder body is not solid like ferrite material, irregularities such as cracks and chips do not affect the electrical properties, or the reliability of the component. Criteria have been determined for the acceptability of the components that allow for a robust manufacturing process as well as an acceptable degree of cosmetic irregularity.

Reliability testing has been done on the effects of cracking of the iron powder body and on the oxidation of the iron particles that are present on the surface. Testing has shown no reliability issues from either of these cosmetic differences.

TYPICAL REFLOW SOLDERING PROFILE

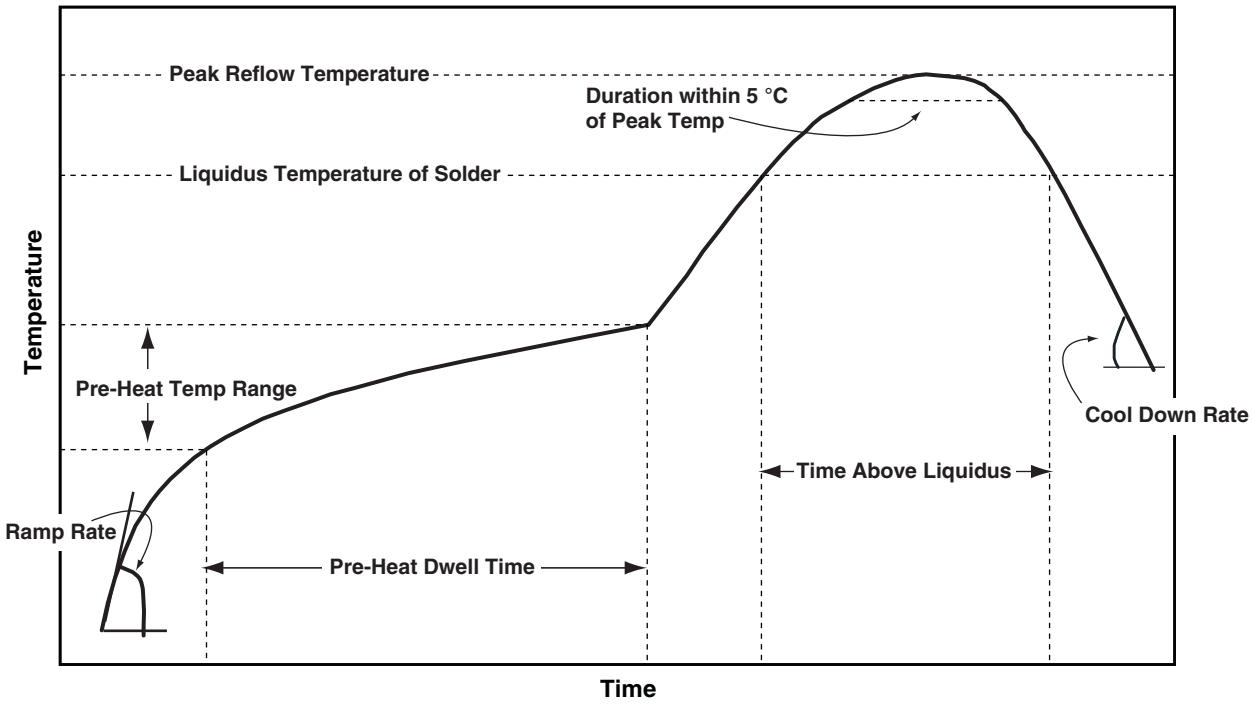


Fig. 1 - Infrared reflow soldering (SMD package)

LEAD (Pb)-FREE SOLDER (SnAgCu) REFLOW PROFILE ATTRIBUTES	
PROFILE ATTRIBUTE	**PROFILE ATTRIBUTE**
Peak Reflow Temperature	255 (± 5) °C
Time within 5 °C of Peak Temperature	30 s max.
Liquidus Temperature of Solder	~ 217 °C
Cool Down Rate	6 °C/s max.
Time above Liquidus	60 s to 150 s
Pre-heat Temperature Range	150 °C to 200 °C
Pre-heat Dwell Time	60 s to 120 s
Maximum Ramp Rate	3 °C/s max.