CAPACITOR UNIT & ACCESSORIES
TEST REPORT

0	05.JUN.18	PRIMERA EMISIÓN	M.S.LEE	H.K.KIM	H.YANG
REV.	**FECHA**	**DESCRIPCIÓN**	**PRE.**	**REV.**	**APP.**

ELABORADO	**REVISADO**	**APROBADO**
M.S.LEE	**H.K.KIM**	**H.YANG**

NOMBRE DEL PROYECTO	**SUMINISTRO DE EQUIPOS, MATERIALES Y SERVICIOS DE STACOM EN LAS SUBESTACIONES PANAMÁ II Y LLANO SÁNCHEZ DE 230 KV**
SUBESTACIÓN	**PANAMA II & LLANO SANCHEZ SUBSTATION**
CLIENTE FINAL	**ETESA**
CONTRATISTA	**HYOSUNG CORPORATION**
TÍTULO	**CAPACITOR UNIT & ACCESSORIES TEST REPORT**

ESCALA	**CONTRATO NO.**	**DOCUMENTO NO.**	**REV.**
NONE	**GG-037-2016**	**ETESA-C-I-006-3**	**0**

ESTADO DE LA REVISÓN

EMISIÓN	MODIFICACIONES
0	PRIMERA EMISIÓN

DOCUMENTO DE REFERENCIA

No.	DOCUMENTO
1	IEEE Standard 18 (2002)
2	ETESA Technical Specification Annex Chapter 3
3	Existing ABB Capacitor Unit Drawing (2GUZ6012 Rev.03)
4	ETESA-C-I-006-1: Capacitor Unit & Accessories Drawing and Specification
5	ETESA-C-I-006-2_Capacitor Unit & Accessories Inspection Test Plan

CUADRO DE ACLARACIONES

No	REQUERIMIENTO/COMENTARIOS	ACLARACIÓN
1		The fuse routine test report is substituted with type test report acc. to IEEE Std C37.41-2000.
2		
3		
4		

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1. FAT Test Report for 35 units

Order: 502143701-10
Customer: Hyosung Corporation

BAM 23.2-200-1W SHUNT CAPACITOR

FAT REPORT

TDT 0122 502143701-10

ABB Xi'an Power Capacitor Company Ltd.

2018.04

ABB

CUSTOMER:Hyosung Corporation

PO:502143701

2018/4/17

ORDER No.: 502143701

PRODUCTION REF.: TD 1801-5133

TYPE: BAM 23.2-200-1W

CAPACITOR TYPE:	BAM 23.2-200-1W
RATED OUTPUT:	200 kvar
RATED VOLTAGE:	23.2 kV
RATED FREQUENCY:	60 Hz
RATED CAPACITANCE:	0.986 μF
TEMP CATEGORY:	-40/+46
STANDARD SPEC:	IEEE Std 18-2002

Each unit has passed the following tests:

1. Preliminary Capacitance test

2. High voltage test:

   a. Terminal to terminal : (145*75%) 108.75 kV DC for 10 Seconds.

3. Capacitance and Loss at 1.0Un AC.

4. Discharge test:

   The measured discharge resistance is within -5% to +5% of 37.5 MΩ

5. Short Circuit Discharge test: kV DC. (N/A)

Tester: Lisa

J. M. Af.

CUSTOMER:Hyosung Corporation

PO:502143701

2018/4/17

ORDER No.: 502143701

PRODUCTION REF.: TD 1801-5133

TYPE:BAM 23.2-200-1W

Serial	C_{atter}(uF)	Loss(‰)	Res(MΩ)
502143701-10-0365	1.0209	0.13	37.1
502143701-10-0380	1.0247	0.12	36.8
502143701-10-0401	1.0265	0.13	37.1
502143701-10-0402	1.0251	0.13	36.7
502143701-10-0406	1.0234	0.13	36.6
502143701-10-0425	1.0299	0.13	36.9
502143701-10-0428	1.0368	0.15	36.8
502143701-10-0429	1.0329	0.13	36.6
502143701-10-0430	1.033	0.13	36.7
502143701-10-0443	1.0299	0.13	37.1
502143701-10-0444	1.0333	0.13	36.7
502143701-10-0445	1.0251	0.15	36.8
502143701-10-0457	1.0337	0.13	37.7
502143701-10-0461	1.0291	0.14	36.8
502143701-10-0469	1.0251	0.12	37.1
502143701-10-0474	1.0288	0.13	37.4
502143701-10-0478	1.0279	0.13	37.1
502143701-10-0482	1.0234	0.13	36.9
502143701-10-0483	1.0246	0.13	36.8
502143701-10-0506	1.027	0.13	37.1
502143701-10-0507	1.0301	0.13	36.9
502143701-10-0508	1.0251	0.13	36.9
502143701-10-0510	1.0235	0.13	36.7
502143701-10-0525	1.032	0.13	37.1
502143701-10-0526	1.0336	0.13	37.1
502143701-10-0529	1.0249	0.12	36.8

CUSTOMER:Hyosung Corporation

PO:502143701

2018/4/17

ORDER No.: 502143701

PRODUCTION REF.: TD 1801-5133

TYPE:BAM 23.2-200-1W

Serial	C_{after}(uF)	Loss(‰)	Res(MΩ)
502143701-10-0571	1.0302	0.15	36.7
502143701-10-0572	1.0254	0.13	36.9
502143701-10-0573	1.0276	0.13	36.6
502143701-10-0579	1.0275	0.13	37.0
502143701-10-0600	1.0266	0.13	36.5
502143701-10-0601	1.0252	0.12	37.2
502143701-10-0609	1.0226	0.13	36.0
502143701-10-0610	1.0269	0.13	36.2
502143701-10-0639	1.0295	0.13	36.6

75%DC = 145.0 × ½ = 108.75 kV

CNTXC

客户监造 75%耐压.

产品试验记录
ROUTINE TEST RECORD

工作令号/Order.No. 5021437 01 -10　　产品型号/Type BAM23.2-200-1W　　参数单编号/Par.No.

额定电容/Rated Cap. 0.986 μF　　放电电阻/Dis. Res. 37.5±50% MΩ　　短路试验/S/C Test — kVDC

极间电压/HV Test T-T 145.0 kV(~~AC~~/DC)　　极对壳试验/T-C — kVAC　　局放/P.D.≤100pC

试验日期/Test Date 2018.04.16　　环境温度/ Temp. 22.1℃　　试验员/ Operator Lisa.安宁.　　MD-1001-

	单元编号 Unit No.	初始电容(μF) initial cap.	高压试验/HV Tests 极间/T-T	局放/P.D.	短路/ S/C	极对壳/T-C	终检/Final Tests 损耗/tgδ(‰)	电容/C(μF)	偏差/deviation	放电电阻 Res.(MΩ)	校正后电容20℃ C(20℃)	备注 Remarks
1	428	1.03	P		/	/	0.13	1.0328		36.6		
2	444	1.04	P		/	/	0.13	1.0333		36.7		
3	445	1.03	P		/	/	0.15	1.0251		36.8		
4	428	1.04	P		/	/	0.15	1.0368		36.8		
5	571	1.03	P		/	/	0.15	1.0302		36.7		
6	630	1.04	P		/	/	0.13	1.0330		36.7		
7	506	1.03	P		/	/	0.13	1.0270		37.1		
8	508	1.03	P		/	/	0.13	1.0251		36.8		
9	443	1.03	P		/	/	0.13	1.0288		37.1		
10	578	1.03	P		/	/	0.13	1.0275		37.0		
11	507	1.03	P		/	/	0.13	1.0301		36.8		
12	425	1.03	P		/	/	0.13	1.0288		36.8		
13	406	1.03	P		/	/	0.13	1.0234		36.6		
14	365	1.02	P		/	/	0.13	1.0208		37.1		
15	478	1.03	P		/	/	0.13	1.0278		37.1		
16	461	1.03	P		/	/	0.16	1.0281		36.8		
17	602	1.03	P		/	/	0.13	1.0251		36.7		
18	482	1.03	P		/	/	0.13	1.0234		36.8		
19	474	1.03	P		/	/	0.13	1.0288		37.4		
20	380	1.03	P		/	/	0.12	1.0247		36.8		
21	457	1.04	P		/	/	0.13	1.0337		37.7		
22	401	1.03	P		/	/	0.13	1.0265		37.1		
23	468	1.03	P		/	/	0.12	1.0251		37.1		
24	483	1.03	P		/	/	0.13	1.0246		36.8		

注：1. 修理品必须在备注栏以"R"注明/The reworked unit should be remarked with 'R' in the last column.

CNTXC

75% DC = 108.75 kV

0~110 客户监造 75%耐压

产品试验记录
ROUTINE TEST RECORD

工作令号/Order.No. J021437 01 -10　　产品型号/Type BAM22.2-200-4W　　参数单编号/Par.No.

额定电容/Rated Cap. 0.986 μF　　放电电阻/Dis. Res. 37.5 ±5% MΩ　　短路试验/S/C Test — kVDC

极间电压/HV Test T-T 145.0 kV(~~AC~~/DC)　　极对壳试验/T-C — kVAC　　局放/P.D.≤100pC

试验日期/Test Date 2018.04.16　　环境温度/ Temp. 24.3℃　　试验员/ Operator Lydia. 周叶萍　　MD-1001-

单元编号	初始电容(μF)	高压试验/HV Tests				0.15\0.20终检/Final Tests			放电电阻	校正后电容20℃	备注
Unit No.	initial cap.	极间/T-T	局放/P.D.	短路/ S/C	极对壳/T-C	损耗/tgδ(‰)	电容/C(μF)	偏差/deviation	Res.(MΩ)	C(20℃)	Remarks
1	629	1.03	P		—	—	0.13	1.0295		36.6		1
2	610	1.03	P		—	—	0.13	1.0269		36.2		2
3	526	1.04	P		—	—	0.13	1.0336		37.1		3
4	600	1.03	P		—	—	0.13	1.0266		36.5		4
5	529	1.03	P		—	—	0.12	1.0249		36.8		5
6	510	1.03	P		—	—	0.13	1.0225		36.7		6
7	609	1.02	P		—	—	0.13	1.0226		36.0		7
8	525	1.03	P		—	—	0.13	1.0320		37.1		8
9	601	1.03	P		—	—	0.12	1.0252		37.2		9
10	572	1.03	P		—	—	0.13	1.0254		36.9		10
11	573	1.03	P		—	—	0.13	1.0276		36.6		11
12					—	—						12
13					—	—						13
14					—	—						14
15					—	—						15
16					—	—						16
17					—	—						17
18					—	—						18
19					—	—						19
20					—	—						20
21					—	—						21
22					—	—						22
23					—	—						23
24					—	—						24

注：1. 修理品必须在备注栏以"R"注明/The reworked unit should be remarked with 'R' in the last column.

2. Routine Test Report for all units

abb

Routine test report

Report No.： TDT 0122 502143701-10

Customer： Hyosung Corporation

Order No.： 502143701-10

Product Type： POWER CAPACITOR

Capacitor Type： 2GUA232200D170

Date： 2018-04-26

ABB Xi'an Power Capacitor Company Ltd.

西安ABB 电力电容器有限公司

NO。158，WenjingRoad，Xian Economic&Technological Development Zone，Shananxi Province，China. Tel: (8629)84221448 Fax: (8629)84287771

中国，陕西，西安，西安经济技术开发区文景路中段158 号邮编：710021 电话：(8629)84221448 传真：(8629)84287771

Test Items:

-Sealing test

-Preliminary capacitance measurement

-Voltage test between terminals

-Final Capacitance Measurement

-Measurement of the tangent of the loss angle of the capacitor

-Test of internal discharge device

Technical data:

Capacitor Type：	2GUA232200D170	
Rated Voltage:	23.2	kV
Rated Output:	200	kvar
Rated Frequency:	60	Hz
Rated Capacitance:	0.986	μF
Temperature Category:	-40/+46	
Standard:	IEEE Std 18-2002	

Test result：

Each unit has passed the test according to IEEE Std 18-2002.

Tester： John

Digitally signed by Lisa-Min Li
DN: cn=Lisa-Min Li, ou=Normal
Date: 2018.04.26 14:16:30 +08'00'

Test description:

- Sealing test

Sealing inspection was performed in the course of the production process.

- Preliminary capacitance measurement

The preliminary capacitance was measured with a reduced voltage not higher than 0.15Un before the voltage test.

- Voltage test between terminals

Voltage of DC 145 kV was applied between terminals of capacitor for 10 seconds.

- Final Capacitance Measurement

Capacitance of each unit was measured at AC 23.2 kV by high voltage bridge after the voltage test.

- Measurement of the tangent of the loss angle of the capacitor

The tangent of the loss angle of each unit was measured at AC 23.2 kV by high voltage bridge.

- Test of internal discharge device

Internal discharge resistance was measured. The measured resistance is within -5 % to 5 % of 37.5MΩ.

Capacitor losses:

The tangent of the loss angle has been measured on all units at rated voltage and standard ambient temperature.

Each unit has been exposed to rated voltage for less than 1 minute during measurement.

The maximum losses corrected to a value which will be obtained after greater than 20 hours energizing time is 0.15 W/kvar.

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
1	502143701-10-0001	1.025	+4	37.0
2	502143701-10-0002	1.025	+4	37.2
3	502143701-10-0003	1.027	+4	37.2
4	502143701-10-0004	1.032	+5	37.4
5	502143701-10-0005	1.032	+5	37.4
6	502143701-10-0006	1.032	+5	37.5
7	502143701-10-0007	1.032	+5	37.5
8	502143701-10-0008	1.026	+4	37.8
9	502143701-10-0009	1.027	+4	37.0
10	502143701-10-0010	1.025	+4	37.2
11	502143701-10-0011	1.019	+3	37.3
12	502143701-10-0012	1.030	+5	37.3
13	502143701-10-0013	1.026	+4	37.3
14	502143701-10-0014	1.027	+4	37.4
15	502143701-10-0015	1.029	+4	37.4
16	502143701-10-0016	1.031	+5	37.2
17	502143701-10-0017	1.029	+4	37.0
18	502143701-10-0018	1.013	+3	37.5
19	502143701-10-0019	1.026	+4	37.1
20	502143701-10-0020	1.025	+4	37.5
21	502143701-10-0021	1.022	+4	37.3
22	502143701-10-0022	1.025	+4	37.2
23	502143701-10-0023	1.024	+4	37.6
24	502143701-10-0024	1.022	+4	37.1
25	502143701-10-0025	1.024	+4	37.4
26	502143701-10-0026	1.021	+4	37.1
27	502143701-10-0027	1.021	+4	37.6
28	502143701-10-0028	1.020	+3	37.0
29	502143701-10-0029	1.016	+3	37.1
30	502143701-10-0030	1.018	+3	37.0
31	502143701-10-0031	1.014	+3	37.5
32	502143701-10-0032	1.026	+4	36.9
33	502143701-10-0033	1.018	+3	37.1
34	502143701-10-0034	1.017	+3	37.3
35	502143701-10-0035	1.015	+3	37.4
36	502143701-10-0036	1.018	+3	37.5
37	502143701-10-0037	1.020	+3	37.1
38	502143701-10-0038	1.010	+2	37.5
39	502143701-10-0039	1.018	+3	37.0
40	502143701-10-0040	1.013	+3	37.2

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
41	502143701-10-0041	1.015	+3	36.8
42	502143701-10-0042	1.011	+3	36.8
43	502143701-10-0043	1.018	+3	37.0
44	502143701-10-0044	1.018	+3	37.1
45	502143701-10-0045	1.026	+4	36.9
46	502143701-10-0046	1.025	+4	36.8
47	502143701-10-0047	1.026	+4	36.8
48	502143701-10-0048	1.027	+4	37.5
49	502143701-10-0049	1.022	+4	37.1
50	502143701-10-0050	1.020	+3	36.8
51	502143701-10-0051	1.014	+3	36.7
52	502143701-10-0052	1.016	+3	36.9
53	502143701-10-0053	1.020	+3	37.1
54	502143701-10-0054	1.024	+4	36.8
55	502143701-10-0055	1.017	+3	36.8
56	502143701-10-0056	1.023	+4	37.5
57	502143701-10-0057	1.018	+3	37.6
58	502143701-10-0058	1.025	+4	37.2
59	502143701-10-0059	1.018	+3	37.1
60	502143701-10-0060	1.011	+3	37.4
61	502143701-10-0061	1.020	+3	36.8
62	502143701-10-0062	1.015	+3	36.9
63	502143701-10-0063	1.014	+3	37.4
64	502143701-10-0064	1.012	+3	37.3
65	502143701-10-0065	1.020	+3	37.6
66	502143701-10-0066	1.025	+4	36.9
67	502143701-10-0067	1.022	+4	37.0
68	502143701-10-0068	1.015	+3	37.2
69	502143701-10-0069	1.023	+4	37.3
70	502143701-10-0070	1.024	+4	37.1
71	502143701-10-0071	1.021	+4	36.9
72	502143701-10-0072	1.018	+3	37.0
73	502143701-10-0073	1.021	+4	37.1
74	502143701-10-0074	1.027	+4	37.1
75	502143701-10-0075	1.024	+4	37.2
76	502143701-10-0076	1.024	+4	37.0
77	502143701-10-0077	1.026	+4	37.4
78	502143701-10-0078	1.027	+4	37.0
79	502143701-10-0079	1.022	+4	37.0
80	502143701-10-0080	1.015	+3	37.8

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
81	502143701-10-0081	1.027	+4	37.4
82	502143701-10-0082	1.028	+4	37.4
83	502143701-10-0083	1.025	+4	37.0
84	502143701-10-0084	1.020	+3	36.9
85	502143701-10-0085	1.024	+4	37.3
86	502143701-10-0086	1.024	+4	37.5
87	502143701-10-0087	1.024	+4	37.2
88	502143701-10-0088	1.023	+4	36.8
89	502143701-10-0089	1.024	+4	36.9
90	502143701-10-0090	1.024	+4	37.0
91	502143701-10-0091	1.026	+4	37.1
92	502143701-10-0092	1.028	+4	37.3
93	502143701-10-0093	1.029	+4	36.9
94	502143701-10-0094	1.019	+3	37.3
95	502143701-10-0095	1.029	+4	37.0
96	502143701-10-0096	1.025	+4	36.9
97	502143701-10-0097	1.023	+4	37.2
98	502143701-10-0098	1.025	+4	37.1
99	502143701-10-0099	1.026	+4	37.0
100	502143701-10-0100	1.025	+4	37.0
101	502143701-10-0101	1.021	+4	37.2
102	502143701-10-0102	1.018	+3	37.2
103	502143701-10-0103	1.026	+4	37.1
104	502143701-10-0104	1.021	+4	37.3
105	502143701-10-0105	1.022	+4	37.2
106	502143701-10-0106	1.017	+3	37.2
107	502143701-10-0107	1.022	+4	37.1
108	502143701-10-0108	1.020	+3	37.0
109	502143701-10-0109	1.020	+3	36.9
110	502143701-10-0110	1.024	+4	37.2
111	502143701-10-0111	1.024	+4	36.9
112	502143701-10-0112	1.023	+4	36.2
113	502143701-10-0113	1.021	+4	37.1
114	502143701-10-0114	1.025	+4	37.1
115	502143701-10-0115	1.017	+3	37.0
116	502143701-10-0116	1.024	+4	37.3
117	502143701-10-0117	1.022	+4	37.0
118	502143701-10-0118	1.022	+4	37.1
119	502143701-10-0119	1.025	+4	36.6
120	502143701-10-0120	1.019	+3	37.1

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
121	502143701-10-0121	1.019	+3	36.9
122	502143701-10-0122	1.020	+3	37.0
123	502143701-10-0123	1.021	+4	37.0
124	502143701-10-0124	1.022	+4	36.9
125	502143701-10-0125	1.019	+3	37.1
126	502143701-10-0126	1.022	+4	36.8
127	502143701-10-0127	1.024	+4	37.2
128	502143701-10-0128	1.024	+4	36.9
129	502143701-10-0129	1.020	+3	36.9
130	502143701-10-0130	1.024	+4	37.1
131	502143701-10-0131	1.020	+3	37.0
132	502143701-10-0132	1.023	+4	37.1
133	502143701-10-0133	1.022	+4	37.2
134	502143701-10-0134	1.021	+4	36.9
135	502143701-10-0135	1.023	+4	37.1
136	502143701-10-0136	1.019	+3	37.2
137	502143701-10-0137	1.021	+4	36.9
138	502143701-10-0138	1.019	+3	36.9
139	502143701-10-0139	1.020	+3	37.0
140	502143701-10-0140	1.019	+3	37.0
141	502143701-10-0141	1.018	+3	36.7
142	502143701-10-0142	1.019	+3	37.2
143	502143701-10-0143	1.021	+4	37.0
144	502143701-10-0144	1.023	+4	36.7
145	502143701-10-0145	1.021	+4	37.0
146	502143701-10-0146	1.023	+4	37.0
147	502143701-10-0147	1.023	+4	37.2
148	502143701-10-0148	1.024	+4	37.2
149	502143701-10-0149	1.023	+4	37.0
150	502143701-10-0150	1.024	+4	37.1
151	502143701-10-0151	1.023	+4	36.9
152	502143701-10-0152	1.025	+4	37.0
153	502143701-10-0153	1.020	+3	37.1
154	502143701-10-0154	1.023	+4	36.6
155	502143701-10-0155	1.021	+4	36.5
156	502143701-10-0156	1.023	+4	37.2
157	502143701-10-0157	1.032	+5	36.9
158	502143701-10-0158	1.026	+4	36.6
159	502143701-10-0159	1.026	+4	37.0
160	502143701-10-0160	1.024	+4	37.1

	Serial No.	Capacitance	Cap.dev.	Resistance
		(μF ,25℃)		(MΩ)
161	502143701-10-0161	1.023	+4	36.9
162	502143701-10-0162	1.023	+4	37.0
163	502143701-10-0163	1.018	+3	37.1
164	502143701-10-0164	1.031	+5	37.1
165	502143701-10-0165	1.023	+4	36.5
166	502143701-10-0166	1.023	+4	37.1
167	502143701-10-0167	1.025	+4	36.8
168	502143701-10-0168	1.025	+4	36.7
169	502143701-10-0169	1.020	+3	36.7
170	502143701-10-0170	1.026	+4	36.6
171	502143701-10-0171	1.027	+4	37.1
172	502143701-10-0172	1.022	+4	36.6
173	502143701-10-0173	1.021	+4	37.0
174	502143701-10-0174	1.027	+4	37.8
175	502143701-10-0175	1.027	+4	37.2
176	502143701-10-0176	1.027	+4	36.9
177	502143701-10-0177	1.028	+4	37.1
178	502143701-10-0178	1.027	+4	36.7
179	502143701-10-0179	1.026	+4	36.8
180	502143701-10-0180	1.022	+4	37.0
181	502143701-10-0181	1.015	+3	37.1
182	502143701-10-0182	1.031	+5	36.7
183	502143701-10-0183	1.020	+3	36.6
184	502143701-10-0184	1.022	+4	37.0
185	502143701-10-0185	1.025	+4	37.0
186	502143701-10-0186	1.027	+4	36.2
187	502143701-10-0187	1.023	+4	37.2
188	502143701-10-0188	1.020	+3	36.4
189	502143701-10-0189	1.022	+4	36.5
190	502143701-10-0190	1.020	+3	36.6
191	502143701-10-0191	1.014	+3	37.1
192	502143701-10-0192	1.018	+3	36.6
193	502143701-10-0193	1.021	+4	36.6
194	502143701-10-0194	1.021	+4	37.1
195	502143701-10-0195	1.023	+4	37.2
196	502143701-10-0196	1.023	+4	37.0
197	502143701-10-0197	1.019	+3	37.3
198	502143701-10-0198	1.020	+3	36.6
199	502143701-10-0199	1.017	+3	36.8
200	502143701-10-0200	1.020	+3	36.5

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
201	502143701-10-0201	1.019	+3	36.7
202	502143701-10-0202	1.016	+3	36.6
203	502143701-10-0203	1.017	+3	37.3
204	502143701-10-0204	1.016	+3	37.0
205	502143701-10-0205	1.019	+3	36.6
206	502143701-10-0206	1.019	+3	36.8
207	502143701-10-0207	1.026	+4	36.9
208	502143701-10-0208	1.022	+4	37.1
209	502143701-10-0209	1.024	+4	36.9
210	502143701-10-0210	1.030	+5	37.1
211	502143701-10-0211	1.024	+4	36.5
212	502143701-10-0212	1.031	+5	37.2
213	502143701-10-0213	1.032	+5	36.4
214	502143701-10-0214	1.035	+5	37.1
215	502143701-10-0215	1.034	+5	37.0
216	502143701-10-0216	1.023	+4	36.9
217	502143701-10-0217	1.033	+5	37.0
218	502143701-10-0218	1.020	+3	37.8
219	502143701-10-0219	1.023	+4	37.1
220	502143701-10-0220	1.022	+4	37.3
221	502143701-10-0221	1.016	+3	37.4
222	502143701-10-0222	1.021	+4	37.2
223	502143701-10-0223	1.019	+3	37.2
224	502143701-10-0224	1.020	+3	37.3
225	502143701-10-0225	1.022	+4	37.0
226	502143701-10-0226	1.021	+4	37.4
227	502143701-10-0227	1.020	+3	37.3
228	502143701-10-0228	1.021	+4	37.3
229	502143701-10-0229	1.025	+4	37.1
230	502143701-10-0230	1.024	+4	37.0
231	502143701-10-0231	1.024	+4	37.1
232	502143701-10-0232	1.023	+4	37.0
233	502143701-10-0233	1.020	+3	37.0
234	502143701-10-0234	1.024	+4	36.6
235	502143701-10-0235	1.024	+4	36.9
236	502143701-10-0236	1.021	+4	37.1
237	502143701-10-0237	1.028	+4	36.7
238	502143701-10-0238	1.022	+4	37.1
239	502143701-10-0239	1.024	+4	36.7
240	502143701-10-0240	1.022	+4	37.0

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
241	502143701-10-0241	1.022	+4	37.2
242	502143701-10-0242	1.019	+3	36.3
243	502143701-10-0243	1.021	+4	36.4
244	502143701-10-0244	1.023	+4	36.7
245	502143701-10-0245	1.021	+4	37.2
246	502143701-10-0246	1.022	+4	37.0
247	502143701-10-0247	1.024	+4	37.1
248	502143701-10-0248	1.017	+3	36.9
249	502143701-10-0249	1.021	+4	37.0
250	502143701-10-0250	1.024	+4	37.5
251	502143701-10-0251	1.031	+5	36.5
252	502143701-10-0252	1.028	+4	36.5
253	502143701-10-0253	1.016	+3	37.2
254	502143701-10-0254	1.030	+5	37.1
255	502143701-10-0255	1.026	+4	36.6
256	502143701-10-0256	1.022	+4	37.0
257	502143701-10-0257	1.030	+5	36.9
258	502143701-10-0258	1.026	+4	37.5
259	502143701-10-0259	1.027	+4	36.9
260	502143701-10-0260	1.026	+4	36.9
261	502143701-10-0261	1.024	+4	36.4
262	502143701-10-0262	1.021	+4	36.6
263	502143701-10-0263	1.034	+5	37.0
264	502143701-10-0264	1.024	+4	37.2
265	502143701-10-0265	1.034	+5	37.1
266	502143701-10-0266	1.025	+4	36.4
267	502143701-10-0267	1.024	+4	37.3
268	502143701-10-0268	1.019	+3	36.5
269	502143701-10-0269	1.029	+4	36.8
270	502143701-10-0270	1.029	+4	36.4
271	502143701-10-0271	1.028	+4	36.7
272	502143701-10-0272	1.034	+5	36.8
273	502143701-10-0273	1.016	+3	36.5
274	502143701-10-0274	1.031	+5	36.3
275	502143701-10-0275	1.031	+5	36.6
276	502143701-10-0276	1.026	+4	36.8
277	502143701-10-0277	1.024	+4	37.0
278	502143701-10-0278	1.023	+4	37.0
279	502143701-10-0279	1.017	+3	36.8
280	502143701-10-0280	1.017	+3	36.9

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
281	502143701-10-0281	1.018	+3	37.1
282	502143701-10-0282	1.026	+4	36.3
283	502143701-10-0283	1.021	+4	36.5
284	502143701-10-0284	1.017	+3	36.8
285	502143701-10-0285	1.024	+4	37.3
286	502143701-10-0286	1.021	+4	36.5
287	502143701-10-0287	1.033	+5	36.9
288	502143701-10-0288	1.017	+3	36.8
289	502143701-10-0289	1.022	+4	36.9
290	502143701-10-0290	1.021	+4	37.0
291	502143701-10-0291	1.025	+4	37.0
292	502143701-10-0292	1.027	+4	37.1
293	502143701-10-0293	1.018	+3	36.8
294	502143701-10-0294	1.028	+4	36.3
295	502143701-10-0295	1.026	+4	37.0
296	502143701-10-0296	1.028	+4	36.7
297	502143701-10-0297	1.025	+4	37.2
298	502143701-10-0298	1.025	+4	36.8
299	502143701-10-0299	1.025	+4	37.1
300	502143701-10-0300	1.026	+4	37.1
301	502143701-10-0301	1.024	+4	37.0
302	502143701-10-0302	1.026	+4	36.5
303	502143701-10-0303	1.026	+4	36.8
304	502143701-10-0304	1.026	+4	37.1
305	502143701-10-0305	1.034	+5	37.0
306	502143701-10-0306	1.022	+4	36.2
307	502143701-10-0307	1.022	+4	37.1
308	502143701-10-0308	1.024	+4	36.6
309	502143701-10-0309	1.023	+4	36.3
310	502143701-10-0310	1.027	+4	36.9
311	502143701-10-0311	1.028	+4	36.6
312	502143701-10-0312	1.020	+3	37.1
313	502143701-10-0313	1.029	+4	37.0
314	502143701-10-0314	1.025	+4	36.6
315	502143701-10-0315	1.025	+4	37.5
316	502143701-10-0316	1.024	+4	37.4
317	502143701-10-0317	1.032	+5	37.2
318	502143701-10-0318	1.024	+4	37.7
319	502143701-10-0319	1.023	+4	37.4
320	502143701-10-0320	1.023	+4	37.4

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
321	502143701-10-0321	1.023	+4	36.6
322	502143701-10-0322	1.022	+4	37.0
323	502143701-10-0323	1.021	+4	37.0
324	502143701-10-0324	1.024	+4	37.1
325	502143701-10-0325	1.022	+4	36.6
326	502143701-10-0326	1.026	+4	37.2
327	502143701-10-0327	1.026	+4	36.5
328	502143701-10-0328	1.025	+4	37.4
329	502143701-10-0329	1.028	+4	37.2
330	502143701-10-0330	1.027	+4	36.9
331	502143701-10-0331	1.026	+4	37.4
332	502143701-10-0332	1.029	+4	36.7
333	502143701-10-0333	1.026	+4	37.6
334	502143701-10-0334	1.021	+4	36.5
335	502143701-10-0335	1.025	+4	36.7
336	502143701-10-0336	1.028	+4	37.0
337	502143701-10-0337	1.028	+4	36.9
338	502143701-10-0338	1.028	+4	36.9
339	502143701-10-0339	1.028	+4	37.1
340	502143701-10-0340	1.030	+5	36.9
341	502143701-10-0341	1.032	+5	37.0
342	502143701-10-0342	1.035	+5	37.4
343	502143701-10-0343	1.037	+5	36.9
344	502143701-10-0344	1.024	+4	36.8
345	502143701-10-0345	1.027	+4	36.6
346	502143701-10-0346	1.029	+4	36.6
347	502143701-10-0347	1.027	+4	36.6
348	502143701-10-0348	1.032	+5	37.0
349	502143701-10-0349	1.032	+5	37.1
350	502143701-10-0350	1.023	+4	36.5
351	502143701-10-0351	1.026	+4	36.7
352	502143701-10-0352	1.020	+3	36.9
353	502143701-10-0353	1.016	+3	37.3
354	502143701-10-0354	1.020	+3	36.9
355	502143701-10-0355	1.024	+4	36.8
356	502143701-10-0356	1.019	+3	37.2
357	502143701-10-0357	1.024	+4	36.7
358	502143701-10-0358	1.022	+4	36.1
359	502143701-10-0359	1.029	+4	36.7
360	502143701-10-0360	1.030	+5	37.0

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
361	502143701-10-0361	1.025	+4	37.0
362	502143701-10-0362	1.022	+4	36.3
363	502143701-10-0363	1.026	+4	37.0
364	502143701-10-0364	1.029	+4	37.2
365	502143701-10-0365	1.019	+3	36.6
366	502143701-10-0366	1.021	+4	37.1
367	502143701-10-0367	1.020	+3	37.2
368	502143701-10-0368	1.023	+4	37.1
369	502143701-10-0369	1.025	+4	37.1
370	502143701-10-0370	1.030	+5	36.9
371	502143701-10-0371	1.024	+4	36.8
372	502143701-10-0372	1.014	+3	36.2
373	502143701-10-0373	1.025	+4	36.1
374	502143701-10-0374	1.030	+5	36.7
375	502143701-10-0375	1.033	+5	37.0
376	502143701-10-0376	1.028	+4	36.9
377	502143701-10-0377	1.020	+3	37.0
378	502143701-10-0378	1.020	+3	36.3
379	502143701-10-0379	1.022	+4	36.0
380	502143701-10-0380	1.023	+4	36.5
381	502143701-10-0381	1.022	+4	36.7
382	502143701-10-0382	1.020	+3	36.4
383	502143701-10-0383	1.026	+4	36.3
384	502143701-10-0384	1.024	+4	36.6
385	502143701-10-0385	1.014	+3	36.4
386	502143701-10-0386	1.031	+5	36.7
387	502143701-10-0387	1.023	+4	37.0
388	502143701-10-0388	1.027	+4	36.9
389	502143701-10-0389	1.027	+4	36.9
390	502143701-10-0390	1.030	+5	36.9
391	502143701-10-0391	1.027	+4	37.1
392	502143701-10-0392	1.029	+4	36.7
393	502143701-10-0393	1.030	+5	36.4
394	502143701-10-0394	1.027	+4	36.5
395	502143701-10-0395	1.017	+3	36.5
396	502143701-10-0396	1.015	+3	36.1
397	502143701-10-0397	1.028	+4	36.4
398	502143701-10-0398	1.019	+3	37.1
399	502143701-10-0399	1.029	+4	36.1
400	502143701-10-0400	1.026	+4	37.1

	Serial No.	Capacitance	Cap.dev.	Resistance
		(μF ,25℃)		(MΩ)
401	502143701-10-0401	1.023	+4	36.5
402	502143701-10-0402	1.023	+4	36.5
403	502143701-10-0403	1.018	+3	36.6
404	502143701-10-0404	1.016	+3	37.1
405	502143701-10-0405	1.022	+4	36.9
406	502143701-10-0406	1.022	+4	36.5
407	502143701-10-0407	1.030	+5	37.2
408	502143701-10-0408	1.020	+3	36.3
409	502143701-10-0409	1.022	+4	37.1
410	502143701-10-0410	1.015	+3	36.9
411	502143701-10-0411	1.017	+3	37.3
412	502143701-10-0412	1.025	+4	37.2
413	502143701-10-0413	1.016	+3	36.4
414	502143701-10-0414	1.013	+3	36.4
415	502143701-10-0415	1.022	+4	37.1
416	502143701-10-0416	1.027	+4	36.7
417	502143701-10-0417	1.021	+4	36.8
418	502143701-10-0418	1.024	+4	37.1
419	502143701-10-0419	1.024	+4	37.1
420	502143701-10-0420	1.013	+3	36.3
421	502143701-10-0421	1.020	+3	37.1
422	502143701-10-0422	1.023	+4	37.0
423	502143701-10-0423	1.027	+4	36.9
424	502143701-10-0424	1.030	+5	37.2
425	502143701-10-0425	1.029	+4	37.1
426	502143701-10-0426	1.029	+4	36.8
427	502143701-10-0427	1.025	+4	36.7
428	502143701-10-0428	1.036	+5	37.1
429	502143701-10-0429	1.032	+5	36.8
430	502143701-10-0430	1.032	+5	37.0
431	502143701-10-0431	1.027	+4	36.7
432	502143701-10-0432	1.025	+4	37.2
433	502143701-10-0433	1.027	+4	37.0
434	502143701-10-0434	1.029	+4	36.4
435	502143701-10-0435	1.030	+5	36.8
436	502143701-10-0436	1.027	+4	36.4
437	502143701-10-0437	1.023	+4	36.6
438	502143701-10-0438	1.022	+4	37.1
439	502143701-10-0439	1.028	+4	37.2
440	502143701-10-0440	1.022	+4	37.0

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
441	502143701-10-0441	1.030	+5	37.2
442	502143701-10-0442	1.024	+4	37.2
443	502143701-10-0443	1.029	+4	37.5
444	502143701-10-0444	1.032	+5	36.8
445	502143701-10-0445	1.024	+4	37.0
446	502143701-10-0446	1.025	+4	36.9
447	502143701-10-0447	1.026	+4	37.0
448	502143701-10-0448	1.024	+4	36.7
449	502143701-10-0449	1.034	+5	36.7
450	502143701-10-0450	1.027	+4	36.9
451	502143701-10-0451	1.032	+5	36.8
452	502143701-10-0452	1.025	+4	37.3
453	502143701-10-0453	1.029	+4	37.5
454	502143701-10-0454	1.026	+4	37.0
455	502143701-10-0455	1.024	+4	36.7
456	502143701-10-0456	1.025	+4	37.0
457	502143701-10-0457	1.028	+4	36.6
458	502143701-10-0458	1.026	+4	36.8
459	502143701-10-0459	1.024	+4	37.2
460	502143701-10-0460	1.032	+5	36.9
461	502143701-10-0461	1.028	+4	36.3
462	502143701-10-0462	1.025	+4	37.0
463	502143701-10-0463	1.031	+5	37.2
464	502143701-10-0464	1.027	+4	36.4
465	502143701-10-0465	1.021	+4	37.0
466	502143701-10-0466	1.023	+4	36.7
467	502143701-10-0467	1.021	+4	36.7
468	502143701-10-0468	1.022	+4	36.5
469	502143701-10-0469	1.024	+4	36.6
470	502143701-10-0470	1.028	+4	36.6
471	502143701-10-0471	1.030	+5	37.4
472	502143701-10-0472	1.029	+4	36.7
473	502143701-10-0473	1.020	+3	36.2
474	502143701-10-0474	1.032	+5	36.2
475	502143701-10-0475	1.030	+5	36.6
476	502143701-10-0476	1.029	+4	36.6
477	502143701-10-0477	1.021	+4	36.4
478	502143701-10-0478	1.026	+4	37.0
479	502143701-10-0479	1.027	+4	36.1
480	502143701-10-0480	1.032	+5	36.8

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
481	502143701-10-0481	1.023	+4	36.6
482	502143701-10-0482	1.022	+4	36.9
483	502143701-10-0483	1.025	+4	36.2
484	502143701-10-0484	1.036	+5	37.4
485	502143701-10-0485	1.020	+3	37.0
486	502143701-10-0486	1.021	+4	37.2
487	502143701-10-0487	1.029	+4	36.0
488	502143701-10-0488	1.017	+3	36.4
489	502143701-10-0489	1.016	+3	36.7
490	502143701-10-0490	1.022	+4	37.0
491	502143701-10-0491	1.015	+3	37.1
492	502143701-10-0492	1.018	+3	36.8
493	502143701-10-0493	1.035	+5	37.0
494	502143701-10-0494	1.025	+4	36.7
495	502143701-10-0495	1.030	+5	37.0
496	502143701-10-0496	1.023	+4	36.8
497	502143701-10-0497	1.026	+4	36.9
498	502143701-10-0498	1.014	+3	36.3
499	502143701-10-0499	1.025	+4	36.5
500	502143701-10-0500	1.028	+4	37.2
501	502143701-10-0501	1.032	+5	37.2
502	502143701-10-0502	1.026	+4	37.0
503	502143701-10-0503	1.026	+4	37.2
504	502143701-10-0504	1.028	+4	36.5
505	502143701-10-0505	1.020	+3	36.2
506	502143701-10-0506	1.026	+4	37.3
507	502143701-10-0507	1.029	+4	37.2
508	502143701-10-0508	1.024	+4	37.2
509	502143701-10-0509	1.021	+4	37.4
510	502143701-10-0510	1.023	+4	36.7
511	502143701-10-0511	1.026	+4	36.4
512	502143701-10-0512	1.031	+5	36.9
513	502143701-10-0513	1.031	+5	37.2
514	502143701-10-0514	1.024	+4	36.6
515	502143701-10-0515	1.027	+4	36.7
516	502143701-10-0516	1.028	+4	36.7
517	502143701-10-0517	1.025	+4	36.0
518	502143701-10-0518	1.024	+4	36.6
519	502143701-10-0519	1.025	+4	37.3
520	502143701-10-0520	1.027	+4	37.3

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
521	502143701-10-0521	1.025	+4	36.8
522	502143701-10-0522	1.033	+5	37.5
523	502143701-10-0523	1.033	+5	37.4
524	502143701-10-0524	1.021	+4	36.7
525	502143701-10-0525	1.031	+5	36.6
526	502143701-10-0526	1.033	+5	36.6
527	502143701-10-0527	1.022	+4	37.7
528	502143701-10-0528	1.031	+5	36.6
529	502143701-10-0529	1.024	+4	36.6
530	502143701-10-0530	1.028	+4	36.9
531	502143701-10-0531	1.022	+4	37.2
532	502143701-10-0532	1.029	+4	37.2
533	502143701-10-0533	1.027	+4	37.0
534	502143701-10-0534	1.025	+4	36.8
535	502143701-10-0535	1.019	+3	37.2
536	502143701-10-0536	1.021	+4	37.5
537	502143701-10-0537	1.021	+4	37.5
538	502143701-10-0538	1.029	+4	36.7
539	502143701-10-0539	1.029	+4	36.9
540	502143701-10-0540	1.035	+5	36.9
541	502143701-10-0541	1.029	+4	37.0
542	502143701-10-0542	1.023	+4	37.3
543	502143701-10-0543	1.031	+5	36.8
544	502143701-10-0544	1.026	+4	37.1
545	502143701-10-0545	1.025	+4	36.5
546	502143701-10-0546	1.027	+4	36.5
547	502143701-10-0547	1.028	+4	36.9
548	502143701-10-0548	1.031	+5	36.4
549	502143701-10-0549	1.029	+4	36.8
550	502143701-10-0550	1.029	+4	37.1
551	502143701-10-0551	1.029	+4	36.6
552	502143701-10-0552	1.023	+4	37.1
553	502143701-10-0553	1.025	+4	37.1
554	502143701-10-0554	1.026	+4	36.2
555	502143701-10-0555	1.027	+4	36.6
556	502143701-10-0556	1.026	+4	37.3
557	502143701-10-0557	1.031	+5	36.5
558	502143701-10-0558	1.023	+4	36.3
559	502143701-10-0559	1.023	+4	37.5
560	502143701-10-0560	1.023	+4	37.3

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
561	502143701-10-0561	1.029	+4	36.4
562	502143701-10-0562	1.025	+4	36.6
563	502143701-10-0563	1.026	+4	36.8
564	502143701-10-0564	1.022	+4	37.0
565	502143701-10-0565	1.022	+4	36.7
566	502143701-10-0566	1.024	+4	36.8
567	502143701-10-0567	1.027	+4	36.8
568	502143701-10-0568	1.027	+4	36.5
569	502143701-10-0569	1.030	+5	37.0
570	502143701-10-0570	1.024	+4	36.3
571	502143701-10-0571	1.029	+4	37.0
572	502143701-10-0572	1.025	+4	36.6
573	502143701-10-0573	1.027	+4	36.7
574	502143701-10-0574	1.027	+4	36.9
575	502143701-10-0575	1.028	+4	36.1
576	502143701-10-0576	1.026	+4	37.3
577	502143701-10-0577	1.026	+4	37.3
578	502143701-10-0578	1.032	+5	37.4
579	502143701-10-0579	1.026	+4	36.9
580	502143701-10-0580	1.016	+3	36.2
581	502143701-10-0581	1.025	+4	36.5
582	502143701-10-0582	1.027	+4	36.6
583	502143701-10-0583	1.025	+4	36.8
584	502143701-10-0584	1.027	+4	36.6
585	502143701-10-0585	1.025	+4	36.4
586	502143701-10-0586	1.026	+4	36.1
587	502143701-10-0587	1.023	+4	36.8
588	502143701-10-0588	1.026	+4	36.8
589	502143701-10-0589	1.025	+4	36.6
590	502143701-10-0590	1.028	+4	36.8
591	502143701-10-0591	1.028	+4	36.1
592	502143701-10-0592	1.026	+4	37.5
593	502143701-10-0593	1.021	+4	36.5
594	502143701-10-0594	1.021	+4	36.0
595	502143701-10-0595	1.023	+4	37.4
596	502143701-10-0596	1.022	+4	36.6
597	502143701-10-0597	1.022	+4	36.9
598	502143701-10-0598	1.025	+4	36.6
599	502143701-10-0599	1.024	+4	37.0
600	502143701-10-0600	1.026	+4	36.5

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
601	502143701-10-0601	1.025	+4	36.7
602	502143701-10-0602	1.022	+4	37.2
603	502143701-10-0603	1.026	+4	37.0
604	502143701-10-0604	1.027	+4	37.1
605	502143701-10-0605	1.021	+4	37.2
606	502143701-10-0606	1.028	+4	37.8
607	502143701-10-0607	1.022	+4	37.6
608	502143701-10-0608	1.025	+4	37.2
609	502143701-10-0609	1.022	+4	36.4
610	502143701-10-0610	1.026	+4	36.3
611	502143701-10-0611	1.026	+4	37.8
612	502143701-10-0612	1.028	+4	36.5
613	502143701-10-0613	1.038	+5	36.5
614	502143701-10-0614	1.027	+4	36.4
615	502143701-10-0615	1.024	+4	36.8
616	502143701-10-0616	1.026	+4	36.8
617	502143701-10-0617	1.024	+4	37.3
618	502143701-10-0618	1.030	+5	36.9
619	502143701-10-0619	1.023	+4	36.9
620	502143701-10-0620	1.026	+4	36.7
621	502143701-10-0621	1.026	+4	36.8
622	502143701-10-0622	1.025	+4	36.5
623	502143701-10-0623	1.028	+4	37.0
624	502143701-10-0624	1.027	+4	37.4
625	502143701-10-0625	1.026	+4	36.6
626	502143701-10-0626	1.025	+4	37.1
627	502143701-10-0627	1.025	+4	36.9
628	502143701-10-0628	1.023	+4	37.2
629	502143701-10-0629	1.023	+4	36.9
630	502143701-10-0630	1.026	+4	37.0
631	502143701-10-0631	1.023	+4	37.0
632	502143701-10-0632	1.026	+4	36.8
633	502143701-10-0633	1.026	+4	36.4
634	502143701-10-0634	1.025	+4	37.1
635	502143701-10-0635	1.026	+4	36.9
636	502143701-10-0636	1.026	+4	36.2
637	502143701-10-0637	1.034	+5	37.0
638	502143701-10-0638	1.032	+5	37.1
639	502143701-10-0639	1.029	+4	36.7
640	502143701-10-0640	1.030	+5	37.7

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
641	502143701-10-0641	1.025	+4	37.4
642	502143701-10-0642	1.026	+4	36.7
643	502143701-10-0643	1.026	+4	36.5
644	502143701-10-0644	1.022	+4	37.4
645	502143701-10-0645	1.021	+4	36.5
646	502143701-10-0646	1.029	+4	36.8
647	502143701-10-0647	1.025	+4	36.8
648	502143701-10-0648	1.023	+4	36.5
649	502143701-10-0649	1.023	+4	37.1
650	502143701-10-0650	1.030	+5	36.3
651	502143701-10-0651	1.026	+4	36.4
652	502143701-10-0652	1.025	+4	37.4
653	502143701-10-0653	1.017	+3	37.2
654	502143701-10-0654	1.024	+4	36.9
655	502143701-10-0655	1.027	+4	37.1
656	502143701-10-0656	1.025	+4	37.2
657	502143701-10-0657	1.026	+4	36.5
658	502143701-10-0658	1.024	+4	37.0
659	502143701-10-0659	1.020	+3	37.2
660	502143701-10-0660	1.027	+4	36.5
661	502143701-10-0661	1.021	+4	37.3
662	502143701-10-0662	1.024	+4	37.2
663	502143701-10-0663	1.024	+4	36.5
664	502143701-10-0664	1.022	+4	36.6
665	502143701-10-0665	1.023	+4	37.4
666	502143701-10-0666	1.021	+4	37.6
667	502143701-10-0667	1.018	+3	37.5
668	502143701-10-0668	1.020	+3	37.2
669	502143701-10-0669	1.022	+4	37.1
670	502143701-10-0670	1.026	+4	36.7
671	502143701-10-0671	1.021	+4	37.2
672	502143701-10-0672	1.020	+3	37.3
673	502143701-10-0673	1.018	+3	37.4
674	502143701-10-0674	1.026	+4	36.5
675	502143701-10-0675	1.027	+4	36.5
676	502143701-10-0676	1.022	+4	37.2
677	502143701-10-0677	1.023	+4	36.7
678	502143701-10-0678	1.024	+4	36.6
679	502143701-10-0679	1.033	+5	36.9
680	502143701-10-0680	1.022	+4	36.5

	Serial No.	Capacitance (μF ,25℃)	Cap.dev.	Resistance (MΩ)
681	502143701-10-0681	1.020	+3	36.7
682	502143701-10-0682	1.019	+3	36.2
683	502143701-10-0683	1.025	+4	36.5
684	502143701-10-0684	1.021	+4	36.5
685	502143701-10-0685	1.021	+4	36.6
686	502143701-10-0686	1.028	+4	36.3
687	502143701-10-0687	1.025	+4	37.3
688	502143701-10-0688	1.026	+4	37.5
689	502143701-10-0689	1.026	+4	36.7
690	502143701-10-0690	1.022	+4	36.5
691	502143701-10-0691	1.022	+4	36.6
692	502143701-10-0692	1.021	+4	36.8
693	502143701-10-0693	1.027	+4	37.0
694	502143701-10-0694	1.028	+4	36.5
695	502143701-10-0695	1.022	+4	37.4
696	502143701-10-0696	1.025	+4	36.5
697	502143701-10-0697	1.022	+4	36.3
698	502143701-10-0698	1.022	+4	37.1
699	502143701-10-0699	1.024	+4	36.7
700	502143701-10-0700	1.023	+4	36.9

TYPE CXP EXPULSION CAPACITOR FUSES

9.7-26.2 kV

March 1995

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ABB Power T&D Company Inc.

INTRODUCTION

Performance testing of the ABB CXP Capacitor Expulsion Fuses was done with reference to the NEMA CP 9-1992, IEEE C37.41e Draft 12 and IEC 549.

1. CXP Fuse Line

The line of capacitor expulsion fuses is designated as the Type CXP fuse line. They are for outdoor use only. The fuses are really a line of fuse holders. They use a replaceable link, typically Type K or T is used for capacitor applications. The fuses are available, with the upper metallic coupling that contains the fusible link, in aluminum or tin plated brass. Both of these fuses are suitable for aluminum bus but only the tin plated version should be used with copper bus.

Primarily the aluminum version of the CXP fuses was tested as indicated on the following pages. Some tests were performed with the tin plated version with no difference in performance.

The CXP fuses are rated 9.7, 16.6 and 26.2 KV. The 16.6 and 26.2 KV CXP fuse are the same fuse.

2. Type Tests

The data that follows will cover the following list of items:

1. Link Range
2. Maximum Capacitive Current Interrupting
3. Minimum Capacitive Current Interrupting
4. Maximum Capacitive Discharge Interrupting
5. Maximum Peak Recovery Voltage Fuse to Clear
6. Maximum 60 Hz Inductive Fault Interrupting
7. Maximum Peak Voltage - Inductive Fault
8. Continuous Current

The Test Summary Sheet as shown in Figure 2 in the Appendix summarizes all of the test data for the CXP fuses.

The CXP fuse test program was conducted during the time from October 1994 thru March 1995. Testing was performed at the Kearney Electrical Research Laboratory in McCook, Ilinois and at PSM Technologies Corporation in East Pittsburgh.

Since the NEMA CP 9-1992, IEEE C37.41e Draft 12 and the IEC 549 standards all vary slightly in their description and paragraph designations, the descripton of the tests in this report will follow the NEMA CP 9-1992 standard as a guideline.

The tests were conducted using a stabilized spring indicator that pulled the operated fuse link out in line with the fuse tube.

3. Link Range

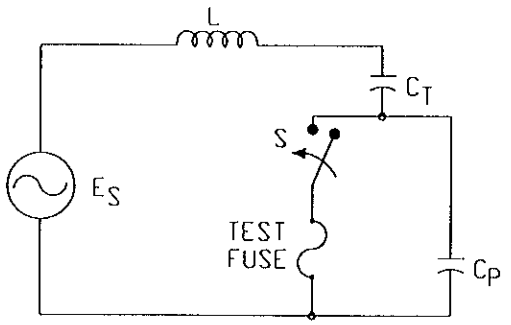
The CXP fuse line uses replaceable fuse links. The standards specify that the minimum and maximum links to be used in the test program. The link range for the three voltage ratings is as follows:

Fuse	Link Range	
	Minimum Link	Maximum Link
9.7 KV	6K	100T
16.6 KV	6K	50T
26.2 KV	6K	50T

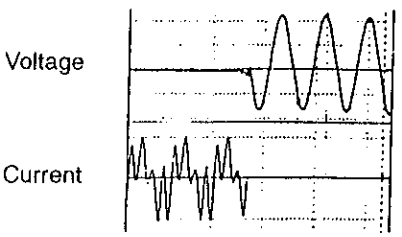
This represents the actual range of fuse links that the fuse holders will accommodate. The test sequences described below used the corresponding minimum and maximum links in the testing program.

4. Maximum Capacitive Current Interrupting (NEMA CP 9-1992, Section 2.5.1 Series A)

The maximum capacitive current interrupting test represents the situation with a high level of capacitive fault current flows thru the fuse in the event that the capacitor shorts completely. The actual current that will flow thru the fuse depends upon the bank connection in the field. In these maximum capacitive current tests, the current selected was the highest level of capacitive current available at the PSM laboratory while supplying the required open circuit voltage across the test fuse.

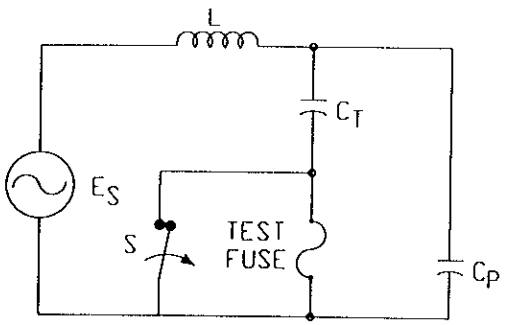


The circuit for the maximum capacitive interrupting current test is shown at the right. Current initially flows thru the capacitor Cp and when switch S is closed then the maximum capacitive current flows thru the test fuse. Three tests were conducted with the minimum link and three tests using the maximum link. In all cases the fuses cleared properly at the current levels listed below:



Maximum Capacitive Current Interrupting			
Fuse	9.7 KV	16.6 KV	26.2 KV
Max Current Rms Amps	1980	2100	835

5. Minimum Capacitive Current Interrupting (NEMA CP 9-1992, Section 2.5.1, Series B)



The minimum capacitive current interrupting test simulates the case where the capacitor being protected by the fuse fails progressively. Thus the level of capacitive current that flows is at a low level. The fuse standards require this current to be just enough to melt the fuse link in a period of several seconds. The current was controlled to cause the link to melt within a 3 to 7 minute time frame. This time requirement is stated in the IEC 549 standard whereas the IEEE C37.41e standard requires this melt time to be just greater than or equal to 10 seconds. In the case for the 16.6 KV fuse the time to melt was slightly longer than the 10 seconds level. However, the 26.2 KV test covers the IEC requirement for the 16.6KV fuse since the 16.6 and 26.2 KV fuse are the same fuse body using the same minimum and maximum links.

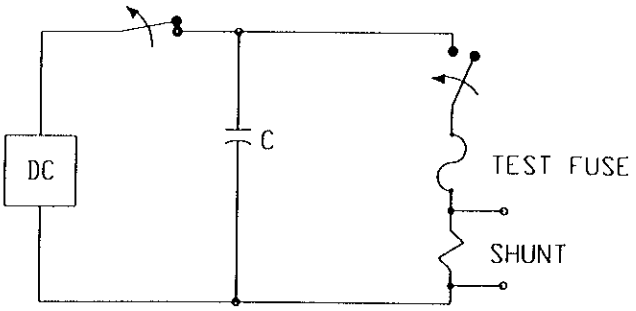
Two tests were conducted using the minimum link and two tests using the maximum link for each rating. The fuses cleared the minimum capacitive current values for these links as follows:

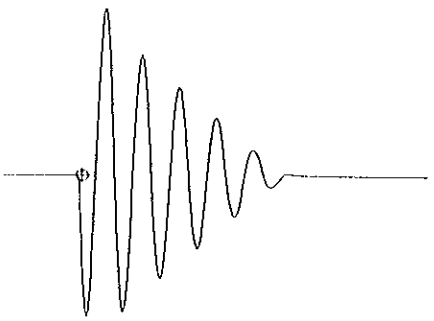
Minimum Capacitive Current Interrupting

Fuse	9.7 KV		16.6 KV		26.2 KV	
Link(Min/Max)	6K	100T	6K	50T	6K	50T
Min Current Rms Amps	13	262	15.6	210	13.5	131

6. Maximum Capacitive Discharge Interruption (NEMA CP 9-1992, 2.5.2.2)

The maximum capacitive discharge interruption test demonstrates the ability of the fuse to withstand a high capacitive discharge energy being dissipated within the fuse. This represents the case where the capacitor shorts completely at the instant of a high voltage peak and the stored energy is absorbed within the CXP fuse.The fuses were tested using the circuit in the adjacent figure. The oscillogram of current is typical.





The capacitors were charged on DC to provide the stored energy values as indicated below. Two tests were performed with the minimum link and two tests were performed with the maximum link for each energy and voltage rating. The table below lists the energy rating obtained at the respective discharge frequencies:

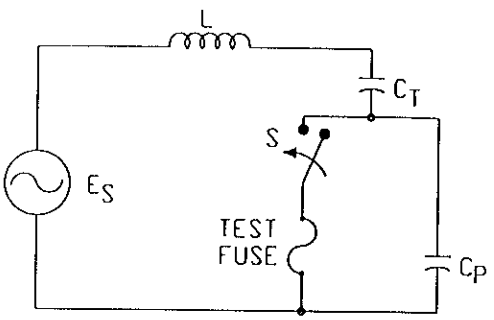
Maximum Capacitive Discharge Interrupting

Fuse	9.7 KV	16.6 KV	26.2 KV
Max Energy Joules and Discharge Freq	30000 @ 1.9KHz	30000 @ 3.7KHz	15000 @ 5.4 KHz
			30000 @ 3.7 KHz

The values listed were not the limit of the fuse but the limit of the test laboratory under the test conditions. The fuses after the tests, were all in excellent condition with minimal mechanical stress induced in the fuse and very limited erosion in the bore of the fuse.

7. Maximum Peak Recovery Voltage Fuse to Clear

The maximum peak voltage which the fuse will clear against is the voltage impressed across the fuse in the circuit in the adjacent figure. This is the maximum capacitive interrupting circuit.



The high recovery voltage applied across the test fuse after the fuse clears occurs due to the tendency of the capacitor across the test fuse to receive a DC offset voltage. The actual recovery voltages during test exceeded those listed below:

Maximum Peak Recovery Voltage Which Fuse Will Clear

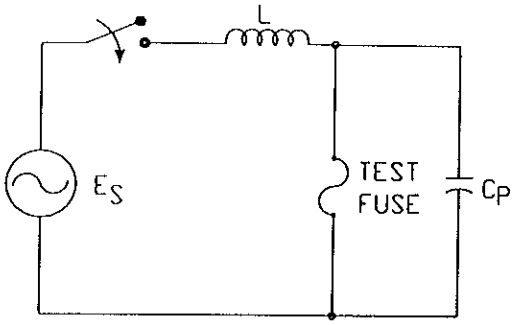
Fuse	9.7 KV	16.6 KV	26.2 KV
Max Clearing Voltage, KV Peak	30.2	51.6	81.2

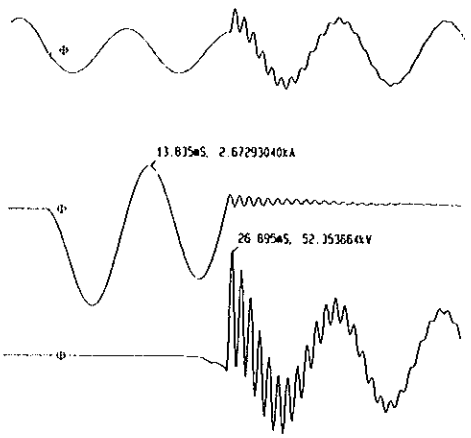
8. Max 60 Hz Inductive Fault Interrupting Max Peak Votage - Inductive Fault

(NEMA CP 9-1992, 2.5 Table 2-2)
(Ref ANSI C37.41 Table 4, Series 1, 2 & 3)

The inductive fault tests simulates the situation in the field where the capacitor fails short and the current that flows is an inductively limited current (no capacitors in series to limit the current). The test requirements per the standards require that the fuses be tested at rated current, 70-80% of rated current and 20-30% of rated current. At the appropriate current levels and voltages, there were three tests using the minimum link and three using the maximum link. The closing angle for these three tests were set to initiate the start of current flow at 0°, 90° and 135° after voltage zero on the voltage wave. In all cases the fuses cleared the faults currents listed below.

The maximum 60 Hz inductive current tests were conducted with the type of test circuit shown to the right. In all cases the X/R ratio of the test circuit was greater than or equal to 15.





The maximum peak inductive voltage is read from the fuse voltage vs. time trace. Note that the 60 Hz test voltage for the 26.2 KV rated fuse was actually performed at 23.0 KV. For this fuse only, if there is a reqirement where inductive faults can actually flow, then this fuse would be limited to a 23 KV design rating rather 26.2 KV. For the other fuses rated 9.7 KV and 16.6 KV, the inductive voltage rating and the capacitive voltage rating are the same. Note: The 10000 amp tests were conducted at 11" centers.

Maximum 60 Hz Inductive Fault
Maximum Peak Voltage - Inductive Fault

Fuse	9.7 KV	16.6 KV	26.2 KV
Test KV	9.7 KV	16.6 KV	23 KV
Max Inductive Amps Rms Asym	10000	5000	2500
Max Inductive Amps Rms Sym	7400	3670	1800
Max Peak Voltage on Inductive Faults KV Peak	27.4	47.0	65.1

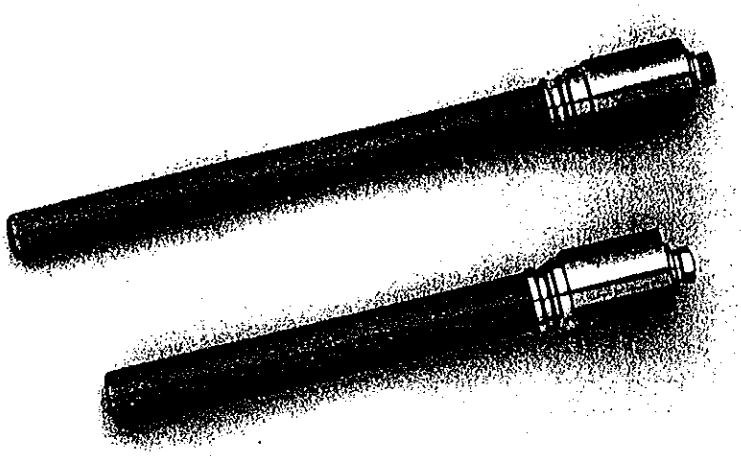
9. Continuous Current

Standards require that an expulsion fuse be able to carry its rated continuous current without exceeding a maximum of 40° C temperature rise above ambient. Two fuse holders of the same ratings were tested with the maximum link rating at a current equal to the link rating. Thus two 9.7 KV fuses with 100T links were tested at 100 amps. On a seperate temperature run two 16.6 KV (26.2 KV) fuses were tested using a 50T link at 50 amps. The fuses were allowed to stabalize (three consecutive 30 minute readings within 1°C). The hot spot temperature rise of the fuse holder was measured on the outside of the metallic coupling just outside of where the fuse link head is held in position. The temperatures rises were very low. The results of the continuous current temperature rise test are as follows:

Fuse	9.7 KV	16.6 or 26.2 KV
Link Tested	100T	50T
Test Current	100	50
Hot Spot Temp Rise °C	6.6	7.9

From this data, it is clear that the temperature rise of the CXP fuse is well below the allowable limit of 40°C. Typically manufacturers of K and T links, allow the link to carry a current of 150% of its link rating. It is expected that the CXP fuse holder from the above tests, will allow this standard application method of operating at 150% of the link rating for links thru the maximum link rating of the fuse.

APPENDIX



Type CXP Fuse

Figure 1

CXP EXPULSION FUSE - TEST SUMMARY SHEET							
	CXP FUSE 1C09100___	A01	A02	A03	A04	A05	A06
	FUSE DESIGN KV, CAPACITIVE	9.7		16.6		26.2	
	FUSE DESIGN KV, INDUCTIVE	9.7		16.6		23.0	
	Material	Aluminum	Tin Plated Brass	Aluminum	Tin Plated Brass	Aluminum	Tin Plated Brass
1	Capacitor Voltage Rating Range KV, Capacitive	2.4-8.8		8.3-15.1		15.1-23.8	
2	Capacitor Voltage Rating Range KV, Inductive	2.4-8.8		8.3-15.1		15.1-20.9	
3	Link Range	6K-100T		6K-50T		6K-50T	
4	Max Capacitive Current Interrupting, Amp	1980		2100		835	
5	Min Capacitive Current Interrupting, Amp	Link Min Melt Current		Link Min Melt Current		Link Min Melt Current	
6	Max Capacitive Discharge , Joules	30000 @ 2.5 KHz		30000 @ 4.5 KHz		15000 @ 6.6 KHz	
						30000 @ 4.5 KHz	
7	Max Peak Recovery KV Fuse to Clear	30.2		51.6		81.2	
8	Max 60 Hz Inductive Fault Int, Asym rms	10000		5000		2500	
9	Max Peak Arc KV - Inductive Fault	27.4		47.0		65.1	
10	Continuous Current (hot spot rise at max link)	6.6 Deg C at 100 Amps		7.9 Deg C at 100 Amps		7.9 Deg C at 100 Amps	

Figure 2