



TRANSFORMER TEST REPORT

BEFORE AND AFTER MAINTENANCE

(Off-Load Transformer Maintank Oil Recondition)

Engineering (M) Sdn. Bhd.

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Engaging trust, empower solution

TRANSFORMER TESTING REPORTS

Location: MPPU KELIAN INTAN

Job: T1 BEFORE SERVICE

Date: 28/08/2023

TRANSFORMER NO : 01
SERIAL NO : 5014
VOLTAGE : 33000/11000
KVA : 5000
MANUFACTURE : MTM
YEAR : 2013
TESTING DATE : 28/08/2023

TEST PERFORMED

S.NO.	TITLE
1	FREQUENCY DOMAIN SPECTROSCOPY(FDS)
2	TANDELTA WINDING
3	EXCITATION CURRENT 10KV
4	TURN RATIO MEASUREMENT
5	DC WINDING RESISTANCE
6	INSULATION RESISTANCE / POLARIZATION INDEX

TEST EQUIPMENT USED :

1. MEGGER IDAX 300
2. MEGGER TDX 120
3. MEGGER TRAX 220
4. MEGGER MIT515 INSULATION TESTER

TESTING PERFORMED BY:

1. VICKNESH A/L SUBRAMANIAM
2. GOBINATH RAJU



TRANSFORMER FREQUENCY DOMAIN SPECTROSCOPY (FDS) TEST REPORT

*SPAJ Electrical
Engineering (M) Sdn. Bhd.*

IDAX Measurement Report

General

Company:	MTM
Division:	PERAK
Location:	MPPU KELIAN INTAN
Date:	28/8/2023

Test conditions

Ambient temperature, °C:	32
Ambient %RH:	72
Object temperature, °C:	45
Weather:	SUNNY
Tester:	VICKNESH

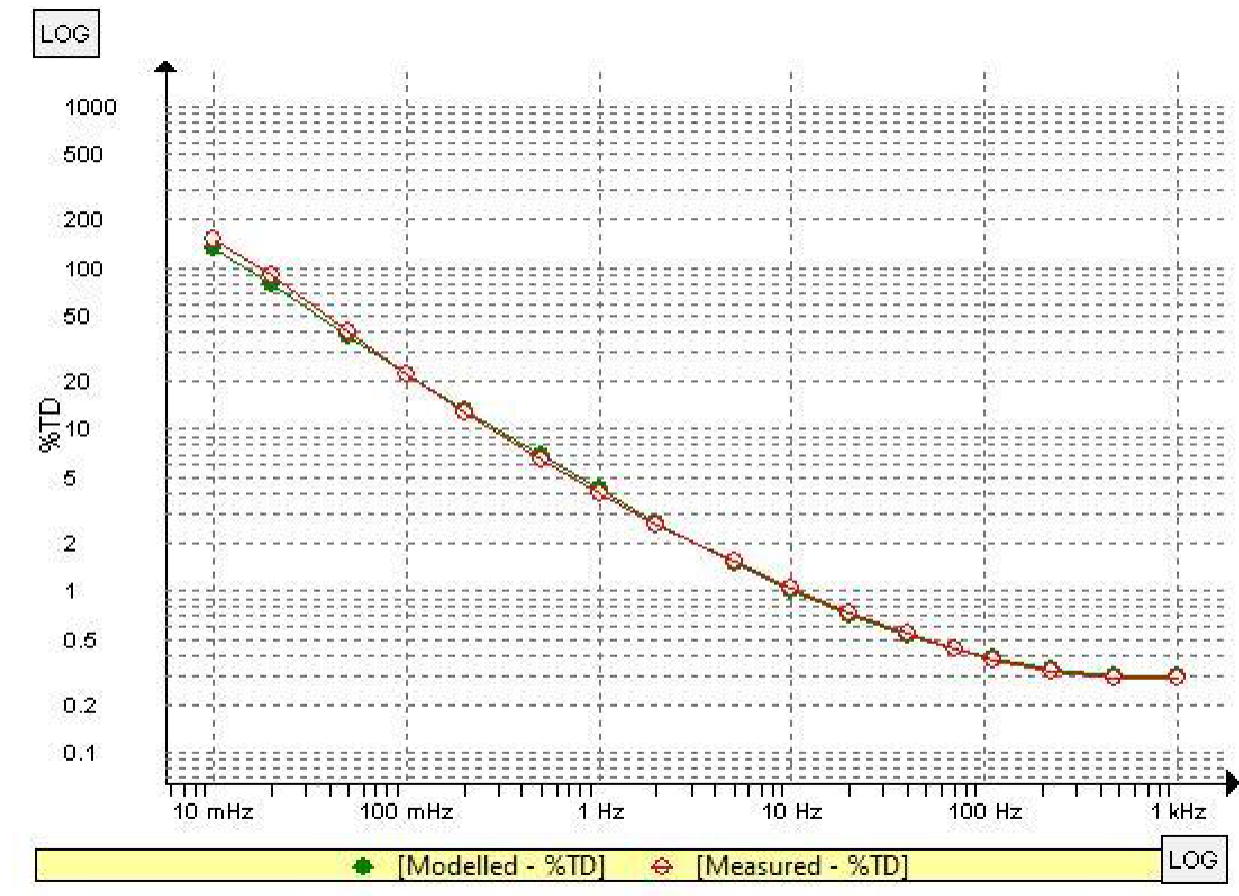
Test object information

Test object:	Two Winding Transformer
Designation:	MINI PPU KELIAN INTAN
Manufacturer:	MTM
Type:	5-201
Core type:	Core
Serial no:	5014
Coolant:	Mineral Oil
Cooling class:	ONAN
Voltage (kV):	33/11
MVA:	5
Vector group:	DYN11
Frequency:	50

Insulation assessment(CHG)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CHG	140	50	1227	0.499	0.309

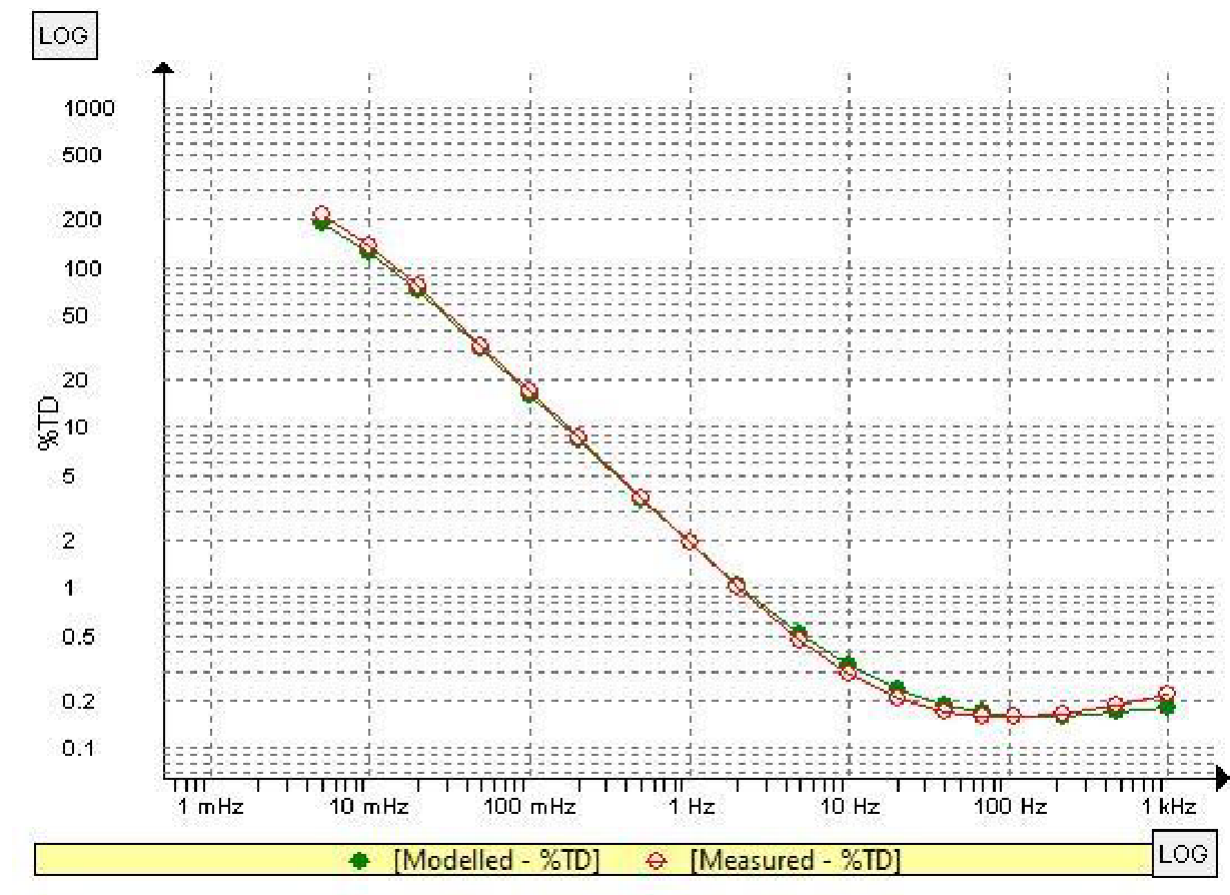
Analysis results		
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.309	2.4	0.013
< 0.30 % As new	< 1.0 % As new	< 0.0060 % As new
0.30 - 0.50 % Good	1.0 - 2.0 % Dry	0.0060 - 0.060 % Good
0.50 - 1.0 % Deteriorated	2.0 - 3.0 % Moderately wet	0.060 - 0.60 % Service aged
> 1.0 % Investigate	> 3.0 % Wet	> 0.60 % Deteriorated



Insulation assessment(CHL)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CHL	140	50	4241	0.162	0.167

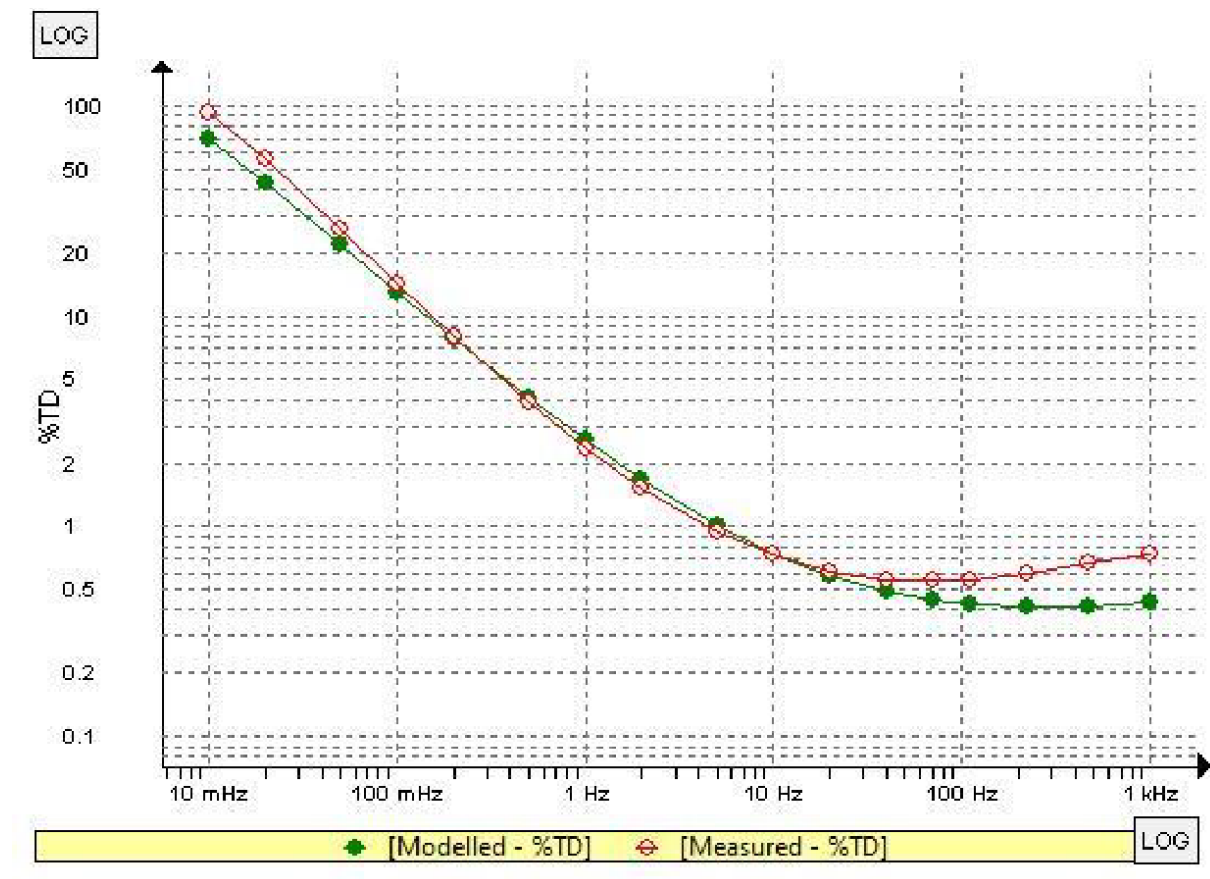
Analysis results		
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.167	1.0	0.015
< 0.30 % As new	< 1.0 % As new	< 0.0060 % As new
0.30 - 0.50 % Good	1.0 - 2.0 % Dry	0.0060 - 0.060 % Good
0.50 - 1.0 % Deteriorated	2.0 - 3.0 % Moderately wet	0.060 - 0.60 % Service aged
> 1.0 % Investigate	> 3.0 % Wet	> 0.60 % Deteriorated



Insulation assessment(CLG)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CLG	140	50	5822	0.554	0.507

Analysis results		
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.507	1.5	0.010
< 0.30 % As new	< 1.0 % As new	< 0.0060 % As new
0.30 - 0.50 % Good	1.0 - 2.0 % Dry	0.0060 - 0.060 % Good
0.50 - 1.0 % Deteriorated	2.0 - 3.0 % Moderately wet	0.060 - 0.60 % Service aged
> 1.0 % Investigate	> 3.0 % Wet	> 0.60 % Deteriorated



MINI PPU KELIAN INTAN 2023-08-28 15.57

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CHG - (28/8/2023 1:52:14 PM)

Test Mode	Hum (50Hz)	Offset	Capacitance (930Hz, 140 (RMS))
UST-R	2.0 nA	6.1 nA	4.2 nF
UST-B	---	---	---
UST-RB	2.0 nA*	6.1 nA*	4.2 nF*
GST-G	4.1 nA*	-5.3 nA*	5.5 nF
GSTg-R	6.1 nA*	806 pA*	1.2 nF*
GSTg-B	4.1 nA*	-5.3 nA*	5.5 nF*
GSTg-RB	6.1 nA	806 pA	1.2 nF

* Estimated from measurements of other Test Modes

Hum current is peak value of the fundamental

1000	1.2192E-09	3.48772E-12	0.286066	0.286064
470	1.22054E-09	3.57453E-12	0.292865	0.292864
220	1.22213E-09	3.92078E-12	0.320817	0.320815
110	1.22372E-09	4.64514E-12	0.379592	0.379589
70	1.22486E-09	5.36887E-12	0.438325	0.438321
40	1.22788E-09	6.67193E-12	0.543371	0.543363
20	1.23046E-09	9.06123E-12	0.736412	0.736392
10	1.23385E-09	1.28514E-11	1.04157	1.04151
5	1.23845E-09	1.88105E-11	1.51887	1.51869
2	1.24573E-09	3.23203E-11	2.59448	2.59361

1	1.25536E-09	5.03903E-11	4.01403	4.0108
0.5	1.26809E-09	8.12262E-11	6.4054	6.3923
0.2	1.29101E-09	1.62984E-10	12.6245	12.5251
0.1	1.31172E-09	2.91086E-10	22.1912	21.6641
0.05	1.34327E-09	5.42051E-10	40.3531	37.4212
0.02	1.43214E-09	1.27198E-09	88.8171	66.4064
0.01	1.59856E-09	2.38158E-09	148.982	83.0301

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CHL - (28/8/2023 1:43:03 PM)

Test Mode	Hum (50Hz)	Offset	Capacitance (930Hz, 140 (RMS))
UST-R	2.2 nA	45 pA	4.2 nF
UST-B	---	---	---
UST-RB	2.2 nA*	45 pA*	4.2 nF*
GST-G	3.6 nA*	-683 pA*	5.5 nF
GSTg-R	5.8 nA*	-638 pA*	1.2 nF*
GSTg-B	3.6 nA*	-683 pA*	5.5 nF*
GSTg-RB	5.8 nA	-638 pA	1.2 nF

* Estimated from measurements of other Test Modes

Hum current is peak value of the fundamental

1000	4.23118E-09	9.17373E-12	0.216813	0.216812
470	4.23298E-09	7.92448E-12	0.187208	0.187208
220	4.23586E-09	6.96474E-12	0.164423	0.164423
110	4.23853E-09	6.59971E-12	0.155708	0.155708
70	4.24017E-09	6.60773E-12	0.155837	0.155836

40	4.2421E-09	7.03751E-12	0.165897	0.165897
20	4.24417E-09	8.57739E-12	0.202098	0.202098
10	4.25101E-09	1.23714E-11	0.291023	0.291021
5	4.2533E-09	2.00658E-11	0.471772	0.471767
2	4.25674E-09	4.29085E-11	1.00802	1.00796
1	4.25436E-09	8.03549E-11	1.88877	1.88843
0.5	4.25963E-09	1.53985E-10	3.61497	3.61261
0.2	4.27202E-09	3.69887E-10	8.65837	8.62609
0.1	4.29405E-09	7.2332E-10	16.8447	16.6107
0.05	4.33343E-09	1.41487E-09	32.6502	31.0377
0.02	4.51907E-09	3.41107E-09	75.4816	60.2457
0.01	4.90921E-09	6.59423E-09	134.324	80.2124
0.005	5.76387E-09	1.24463E-08	215.936	90.7419

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CLG - (28/8/2023 1:57:56 PM)

Test Mode	Hum (50Hz)	Offset	Capacitance (930Hz, 140 (RMS))
UST-R	3.9 fA	-1.0 nA	4.2 nF
UST-B	---	---	---
UST-RB	3.9 fA*	-1.0 nA*	4.2 nF*
GST-G	5.0 nA*	1.4 nA*	10.0 nF
GSTg-R	5.0 nA*	382 pA*	5.8 nF*
GSTg-B	5.0 nA*	1.4 nA*	10.0 nF*
GSTg-RB	5.0 nA	382 pA	5.8 nF

* Estimated from measurements of other Test Modes

Hum current is peak value of the fundamental

1000	5.76331E-09	4.22494E-11	0.733075	0.733055
470	5.78138E-09	3.86898E-11	0.669215	0.6692
220	5.79771E-09	3.48635E-11	0.601333	0.601322
110	5.81006E-09	3.25012E-11	0.559394	0.559385
70	5.81726E-09	3.19006E-11	0.548377	0.548369
40	5.82578E-09	3.24793E-11	0.557511	0.557502
20	5.83605E-09	3.57841E-11	0.613157	0.613145
10	5.84655E-09	4.26469E-11	0.729438	0.729419
5	5.86525E-09	5.54626E-11	0.945615	0.945573
2	5.88577E-09	8.89161E-11	1.5107	1.51052
1	5.9044E-09	1.37585E-10	2.3302	2.32957
0.5	5.92237E-09	2.27019E-10	3.83325	3.83043
0.2	5.97236E-09	4.74235E-10	7.94049	7.91557
0.1	6.03202E-09	8.6365E-10	14.3178	14.1732
0.05	6.13792E-09	1.61016E-09	26.2329	25.3744
0.02	6.57003E-09	3.68779E-09	56.1306	48.947
0.01	7.43852E-09	6.82842E-09	91.7981	67.625



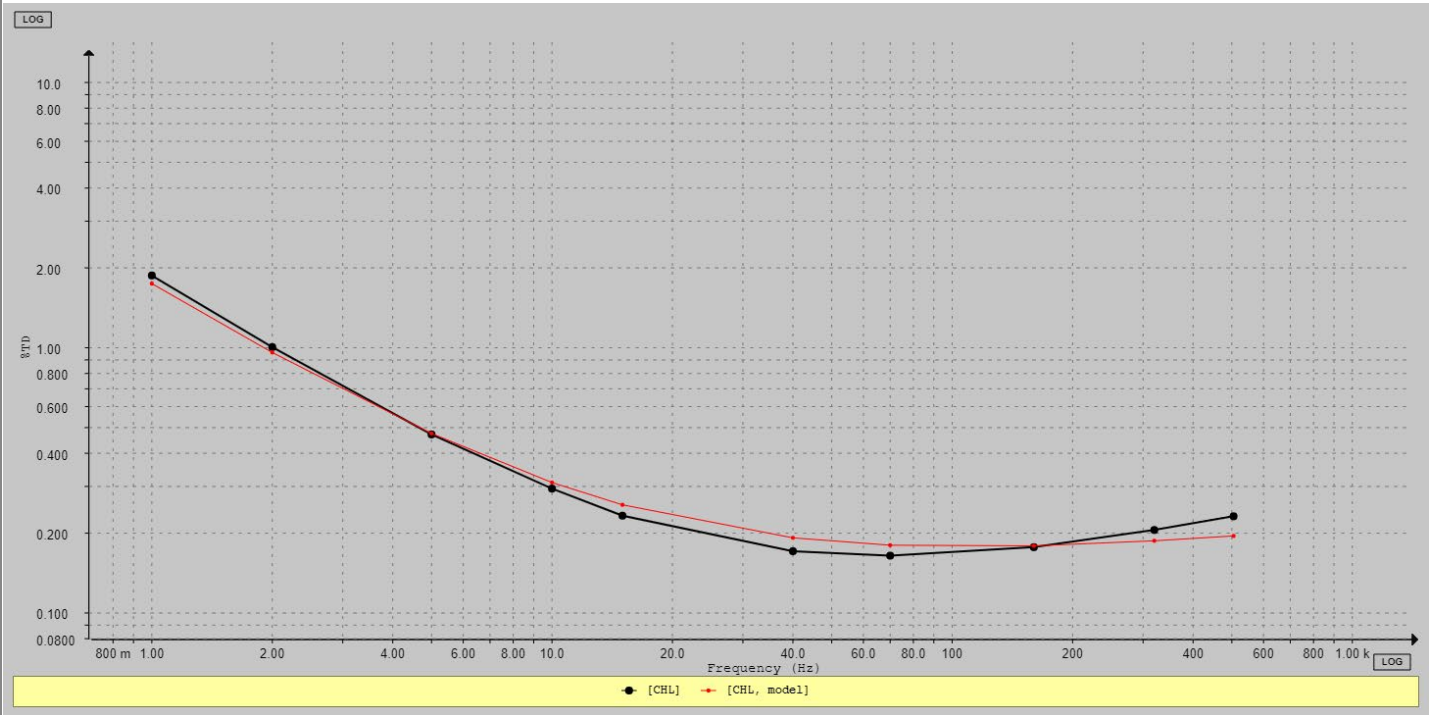
TRANSFORMER TAN DELTA TEST REPORT

*SPAJ Electrical
Engineering (M) Sdn. Bhd.*



Tan Delta - Power Transformer

Designation	Test Mode	f (Hz)	U	I eq	C	%TD at 38 °C	ITC2 Corr. Factor	Corr. %TD to 20°C	P eq at 38 °C	% VDF	ITC2
CHG + CHL	GST-GND	50.00	6.001 kV	17.15 mA	5.459 nF	0.241	1.066	0.257	413.0 mW	0.01 %	
CHG	GSTg-RB	50.00	6.002 kV	3.849 mA	1.225 nF	0.494	1.066	0.526	190.0 mW	0.02 %	
CHL	UST-R	50.00	6.001 kV	13.30 mA	4.234 nF	0.167	1.066	0.178	222.3 mW	0.01 %	
CLG + CLH	GST-GND	50.00	6.002 kV	26.07 mA	8.299 nF	0.243	1.066	0.259	632.9 mW	0.01 %	
CLG	GSTg-RB	50.00	6.002 kV	12.77 mA	4.065 nF	0.319	1.066	0.340	407.0 mW	0.02 %	
CLH	UST-R	50.00	6.002 kV	13.30 mA	4.234 nF	0.169	1.066	0.180	224.3 mW	0.01 %	



Comment:



TRANSFORMER EXCITATION 10KV TEST REPORT

*SPAJ Electrical
Engineering (M) Sdn. Bhd.*



Tan Delta - Power Transformer Excitation

Connection	Tap	Tap Voltage (V)	f (Hz)	U	I eq	L	P eq at 40 °C
A-B	1	34 650	50.00	10.00 kV	23.91 mA	2.319 kH	195.8 W
B-C	1	34 650	50.00	9.998 kV	8.423 mA	8.671 kH	75.81 W
C-A	1	34 650	50.00	9.995 kV	21.14 mA	2.822 kH	178.8 W
A-B	2	33 825	50.00	9.994 kV	24.40 mA	2.306 kH	201.2 W
B-C	2	33 825	50.00	10.01 kV	8.740 mA	8.552 kH	79.08 W
C-A	2	33 825	50.00	10.01 kV	21.98 mA	2.733 kH	186.4 W
A-B	3	33 000	50.00	10.01 kV	25.13 mA	2.263 kH	208.3 W
B-C	3	33 000	50.00	9.999 kV	9.074 mA	8.453 kH	82.56 W
C-A	3	33 000	50.00	10.01 kV	22.89 mA	2.648 kH	194.7 W
A-B	4	32 175	50.00	10.01 kV	26.14 mA	2.190 kH	217.2 W
B-C	4	32 175	50.00	10.00 kV	9.453 mA	8.316 kH	86.43 W
C-A	4	32 175	50.00	9.990 kV	23.87 mA	2.559 kH	203.8 W
A-B	5	31 350	50.00	9.958 kV	27.20 mA	2.124 kH	227.0 W
B-C	5	31 350	50.00	9.991 kV	9.897 mA	8.113 kH	90.86 W
C-A	5	31 350	50.00	10.00 kV	24.90 mA	2.482 kH	213.4 W

Comment:



TRANSFORMER TURNS RATIO TEST REPORT

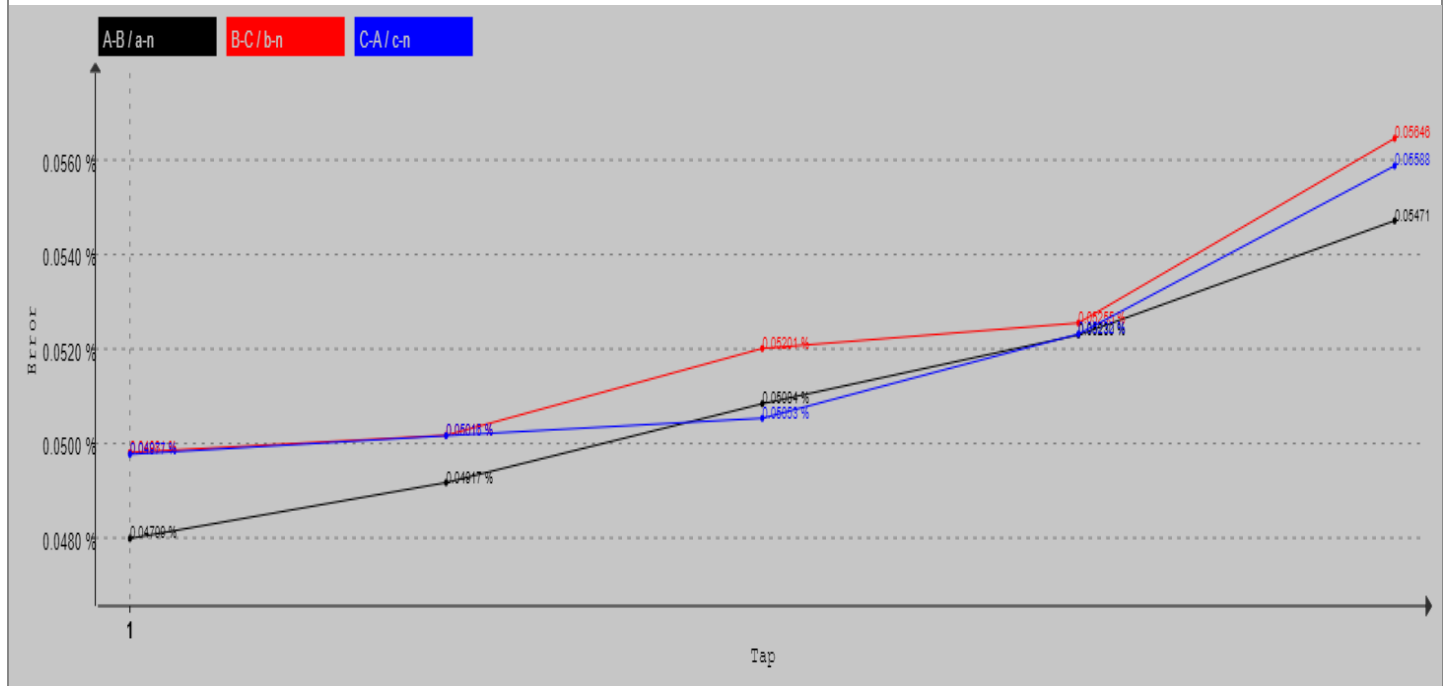
*SPAJ Electrical
Engineering (M) Sdn. Bhd.*



Turns ratio measurements

Connection	Tap (P)	Tap Voltage (V)	U	Test frequency	TTR	Measured TTR	Error	I Exc	Phase
A-B / a-n	1	34 650	250.1 V	50.00 Hz	5.456	5.459	0.05 %	1.603 mA	0.0 °
B-C / b-n	1	34 650	250.1 V	50.00 Hz	5.456	5.459	0.05 %	1.188 mA	0.0 °
C-A / c-n	1	34 650	250.0 V	50.00 Hz	5.456	5.459	0.05 %	1.554 mA	0.0 °
A-B / a-n	2	33 825	250.0 V	50.00 Hz	5.326	5.329	0.05 %	1.660 mA	0.0 °
B-C / b-n	2	33 825	250.1 V	50.00 Hz	5.326	5.329	0.05 %	1.238 mA	0.0 °
C-A / c-n	2	33 825	250.1 V	50.00 Hz	5.326	5.329	0.05 %	1.616 mA	0.0 °
A-B / a-n	3	33 000	250.0 V	50.00 Hz	5.196	5.199	0.05 %	1.719 mA	0.0 °
B-C / b-n	3	33 000	250.1 V	50.00 Hz	5.196	5.199	0.05 %	1.288 mA	0.0 °
C-A / c-n	3	33 000	250.1 V	50.00 Hz	5.196	5.199	0.05 %	1.680 mA	0.0 °
A-B / a-n	4	32 175	250.1 V	50.00 Hz	5.066	5.069	0.05 %	1.794 mA	0.0 °
B-C / b-n	4	32 175	250.1 V	50.00 Hz	5.066	5.069	0.05 %	1.348 mA	0.0 °
C-A / c-n	4	32 175	250.1 V	50.00 Hz	5.066	5.069	0.05 %	1.754 mA	0.0 °
A-B / a-n	5	31 350	250.1 V	50.00 Hz	4.936	4.939	0.05 %	1.870 mA	0.0 °
B-C / b-n	5	31 350	250.1 V	50.00 Hz	4.936	4.939	0.06 %	1.424 mA	0.0 °
C-A / c-n	5	31 350	250.1 V	50.00 Hz	4.936	4.939	0.06 %	1.829 mA	0.0 °

Comment:





**SPAJ Electrical
Engineering (M) Sdn. Bhd.**

RECOGNIZED AND CERTIFIED USER OF **Megger**



TRANSFORMER DC WINDING RESISTANCE TEST REPORT

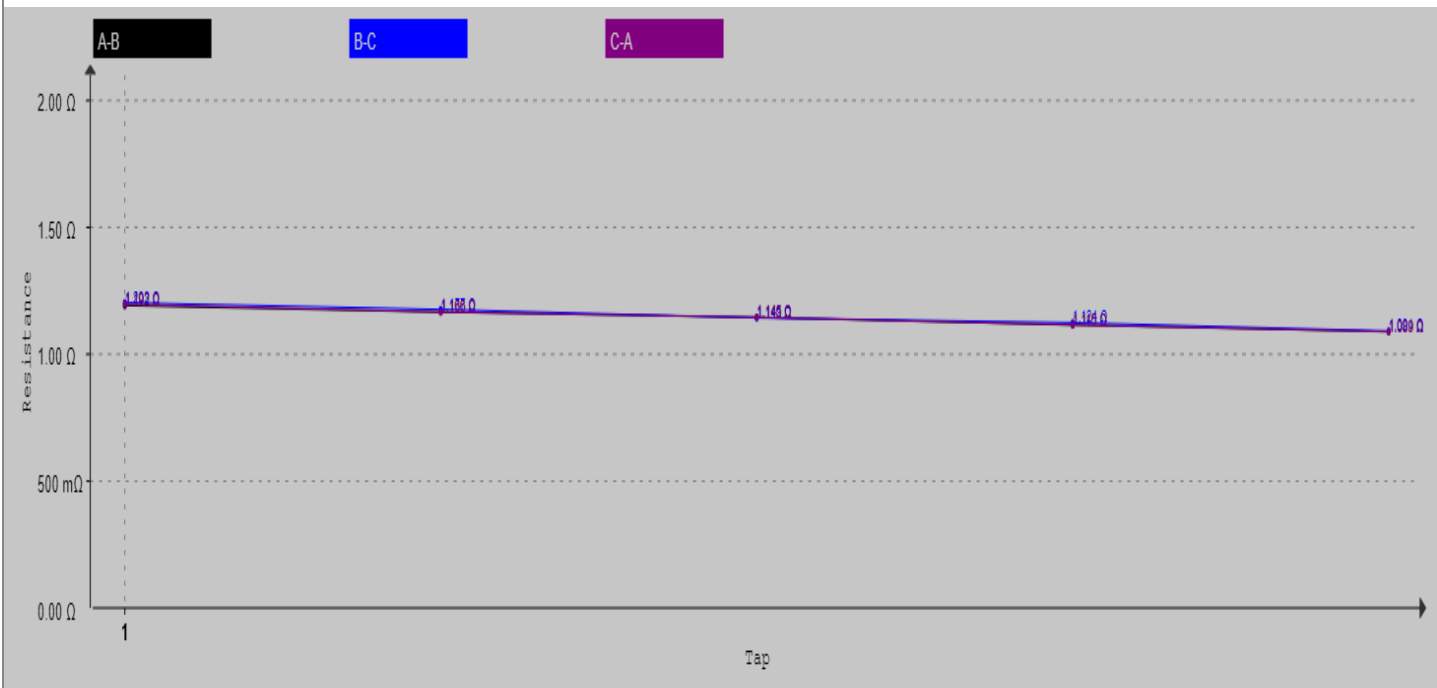
*SPAJ Electrical
Engineering (M) Sdn. Bhd.*



HV Winding resistance measurements

Connection	▼ Tap (P)	Current	38°C Resistance corrected to 75°C	Stability	Variation
A-B	1	10.17 A	1.353 Ω	99.98 %	---
B-C	1	10.00 A	1.366 Ω	99.64 %	---
C-A	1	10.00 A	1.359 Ω	99.84 %	0.96 %
A-B	2	10.13 A	1.324 Ω	99.91 %	---
B-C	2	10.00 A	1.336 Ω	99.70 %	---
C-A	2	10.16 A	1.324 Ω	99.96 %	0.91 %
A-B	3	9.993 A	1.301 Ω	99.80 %	---
B-C	3	10.16 A	1.298 Ω	100.0 %	---
C-A	3	10.00 A	1.301 Ω	99.82 %	0.21 %
A-B	4	10.13 A	1.266 Ω	99.97 %	---
B-C	4	10.00 A	1.277 Ω	99.78 %	---
C-A	4	10.14 A	1.267 Ω	99.93 %	0.83 %
A-B	5	10.10 A	1.237 Ω	99.87 %	---
B-C	5	10.16 A	1.239 Ω	99.99 %	---
C-A	5	10.14 A	1.237 Ω	99.94 %	0.22 %

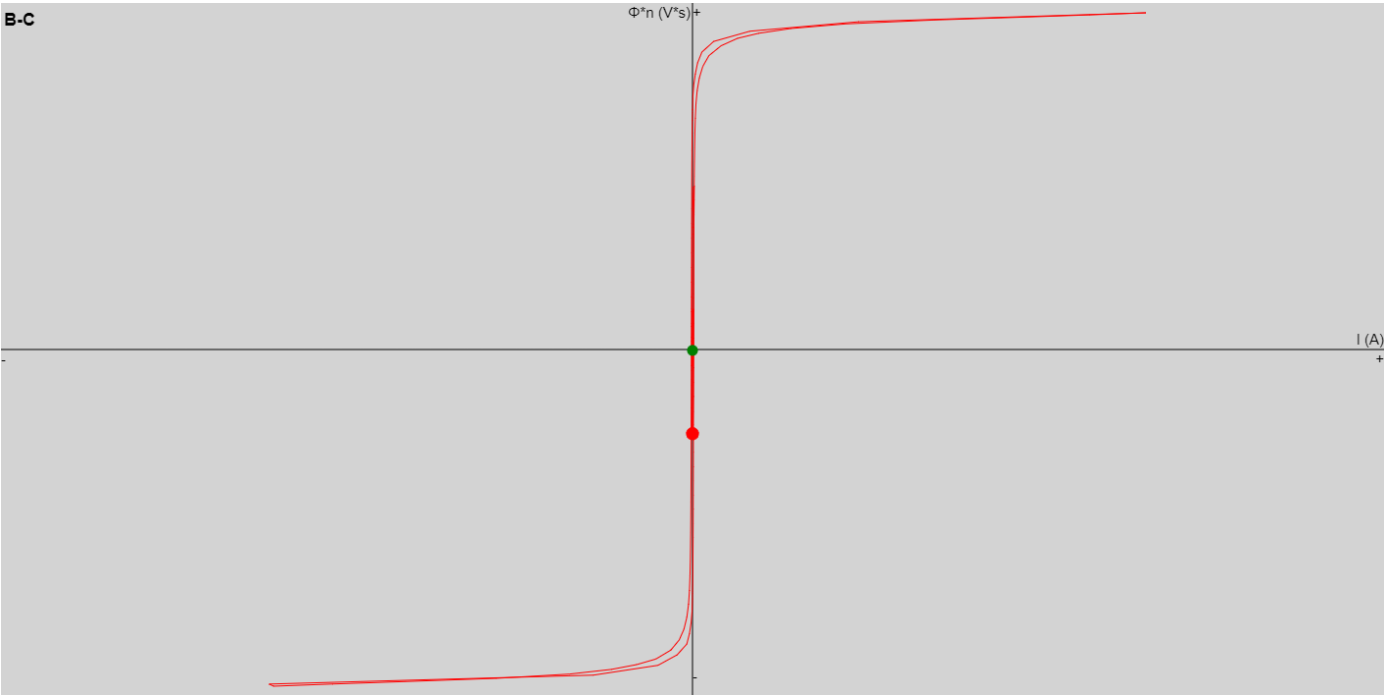
Comment:





Demag measurements

Designation	Current	Time	Remanence before demag	Remanence after demag
B-C	0.000 A	36.73 s	24.76 %	<1 %



Comment:



LV Winding resistance measurements

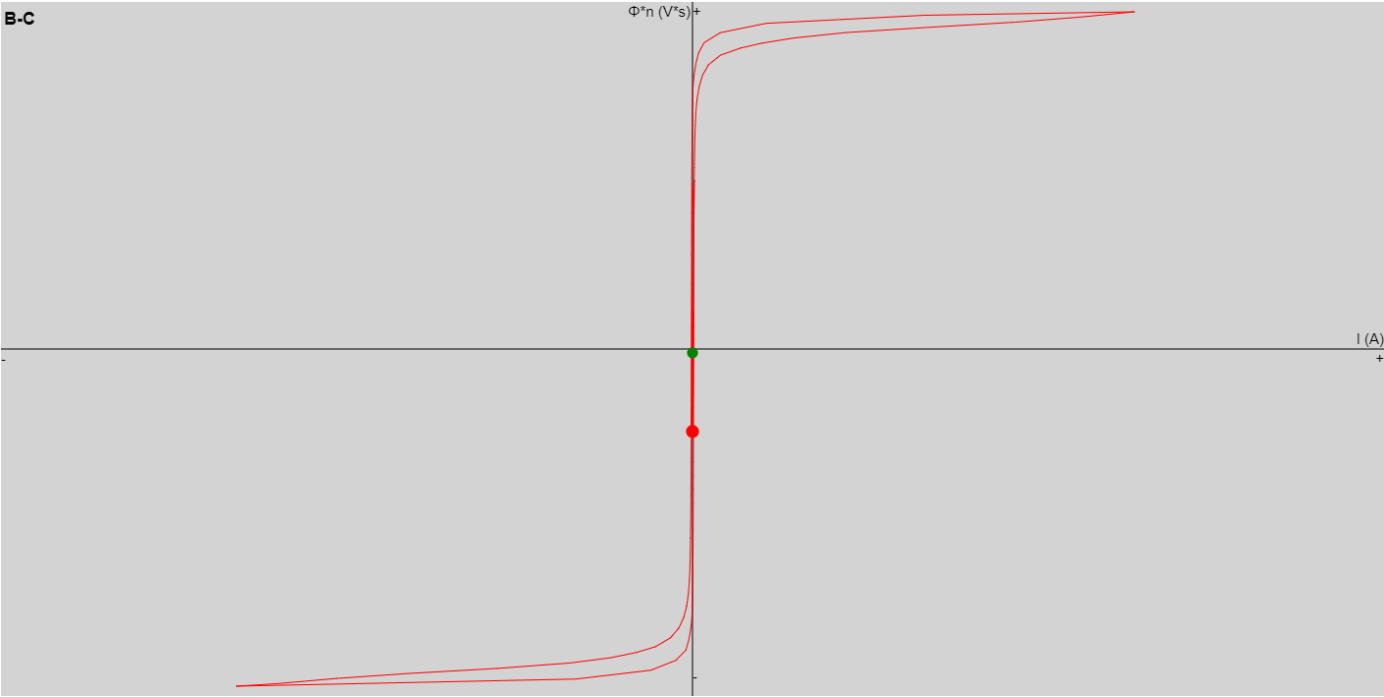
Connection	Tap (S)	Current	38°C Resistance corrected to 75°C	Stability	Variation
a-n	1	10.00 A	63.82 mΩ	99.75 %	---
b-n	1	9.998 A	64.15 mΩ	99.98 %	---
c-n	1	10.00 A	64.07 mΩ	99.67 %	0.52 %

Comment:



Demag measurements

Designation	Current	Time	Remanence before demag	Remanence after demag
B-C	0.000 A	40.29 s	24.33 %	1.118 %



Comment:



TRANSFORMER INSULATION RESISTANCE TEST REPORT

*SPAJ Electrical
Engineering (M) Sdn. Bhd.*



**SPAJ Electrical
Engineering (M) Sdn. Bhd.**

TEST CERTIFICATE
POWER TRANSFORMER TEST

RECOGNIZED AND CERTIFIED USER OF **Megger**

Client : TENAGA NASIONAL BERHAD	Main Contractor : MALAYSIA TRANSFORMER MANUFACTURING SDN BHD
Station : MPPU KELIAN INTAN	Manufacture year: 2013
Circuit : 33/11KV MTM TRANSFORMER :1	Serial No.: 5014
BAY ID: TX1	

INSULATION RESISTANCE & POLIRIZATION TEST

For Tr. Winding

1. 5kV Megger Insulation Reading

1) TNB Standards Insulation = 1 G OHMS

2) Polarization Index = (R 10 M/ R1M)

BEFORE SERVICE:

<u>MAINTANANCE :</u>									
TRANSFORMER INSULATION									
<u>1 Min Reading:</u>				<u>10 Min Reading :</u>				<u>Polarization</u>	
								<u>Index > 1.2</u>	
HV To E :	2060	MΩ		HV To E :	2500	MΩ		1.213592	
LV To E :	1870	MΩ		LV To E :	2300	MΩ		1.229947	
HVToLV:	1460	MΩ		HVToLV:	1800	MΩ		1.232877	

NOTE: AMBIENT TEMPERATURE: 36 °C

OIL TEMPERATURE: 48 °C

TIME : 10.40 AM

Tested by:	Witnessed by:	Verified by :	ESE COMMENT:
Name: VICKNESH Dept: Tester	Name: Mr. FAKRUL Dept: TNB	Name: Dept:	
Date: 28/08/2023	Date: 28/08/2023	Date: 28/08/2023	

TRANSFORMER TESTING REPORTS

Location: MPPU KELIAN INTAN

Job: T1 AFTER SERVICE

Date: 31/08/2023

TRANSFORMER NO : 01
SERIAL NO : 5014
VOLTAGE : 33000/11000
KVA : 5000
MANUFACTURE : MTM
YEAR : 2013
TESTING DATE : 31/08/2023

TEST PERFORMED

S.NO.	TITLE
1	FREQUENCY DOMAIN SPECTROSCOPY(FDS)
2	TANDELTA WINDING
3	EXCITATION CURRENT 10KV
4	TURN RATIO MEASUREMENT
5	DC WINDING RESISTANCE
6	INSULATION RESISTANCE / POLARIZATION INDEX

TEST EQUIPMENT USED :

1. MEGGER IDAX 300
2. MEGGER TDX 120
3. MEGGER TRAX 220
4. MEGGER MIT515 INSULATION TESTER

TESTING PERFORMED BY:

1. VICKNESH A/L SUBRAMANIAM
2. GOBINATH RAJU



TRANSFORMER FREQUENCY DOMAIN SPECTROSCOPY (FDS) TEST REPORT

*SPAJ Electrical
Engineering (M) Sdn. Bhd.*

IDAX Measurement Report

General

Company:	MTM
Division:	PERAK
Location:	MPPU KELIAN INTAN T1
Date:	31/8/2023

Test conditions

Ambient temperature, °C:	32
Ambient %RH:	72
Object temperature, °C:	45
Weather:	SUNNY
Tester:	VICKNESH

Test object information

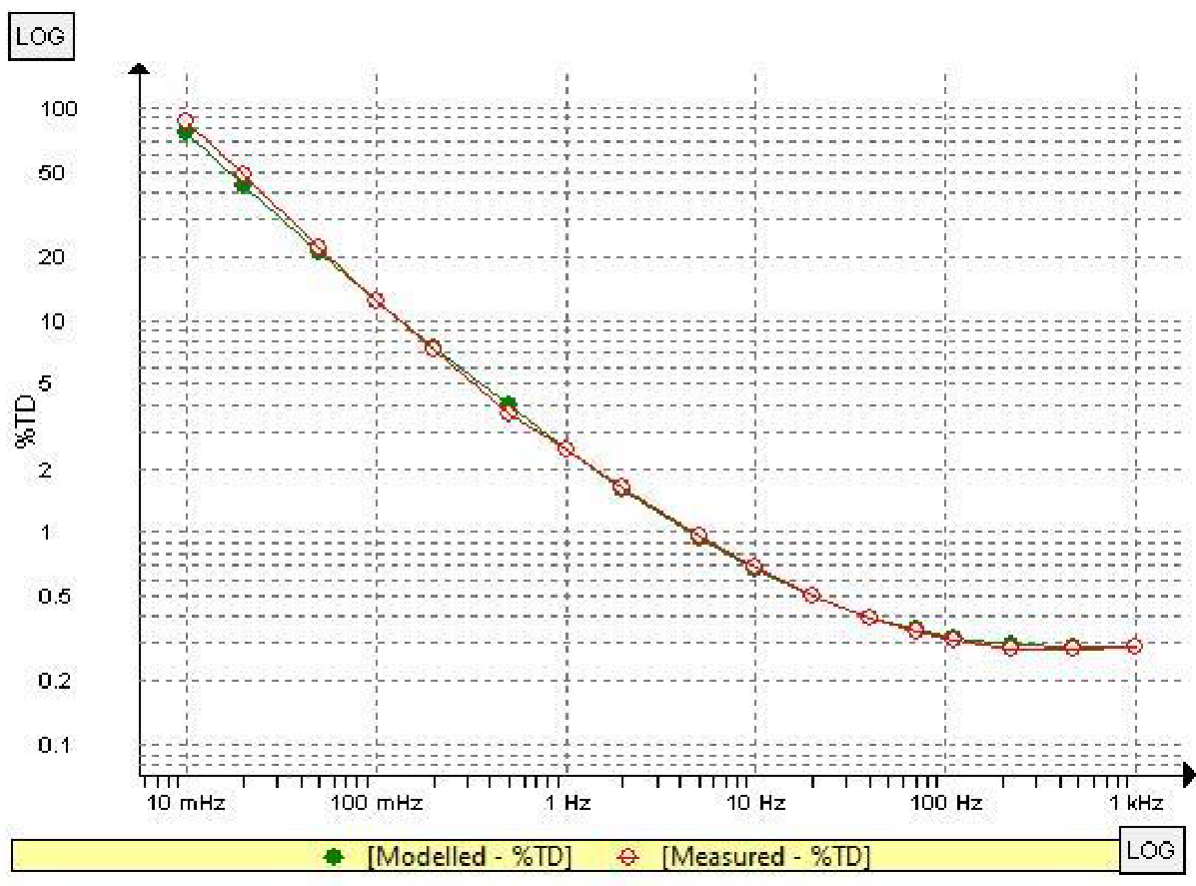
Test object:	Two Winding Transformer
Designation:	MINIPPUKELIANINTANAFter
Manufacturer:	MTM
Type:	5-201
Core type:	Core
Serial no:	5014
Coolant:	Mineral Oil
Cooling class:	ONAN
Voltage (kV):	33/11
MVA:	5
Vector group:	DYN11
Frequency:	50

Insulation assessment(CHG)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CHG	140	50	1227	0.374	0.291

Analysis results

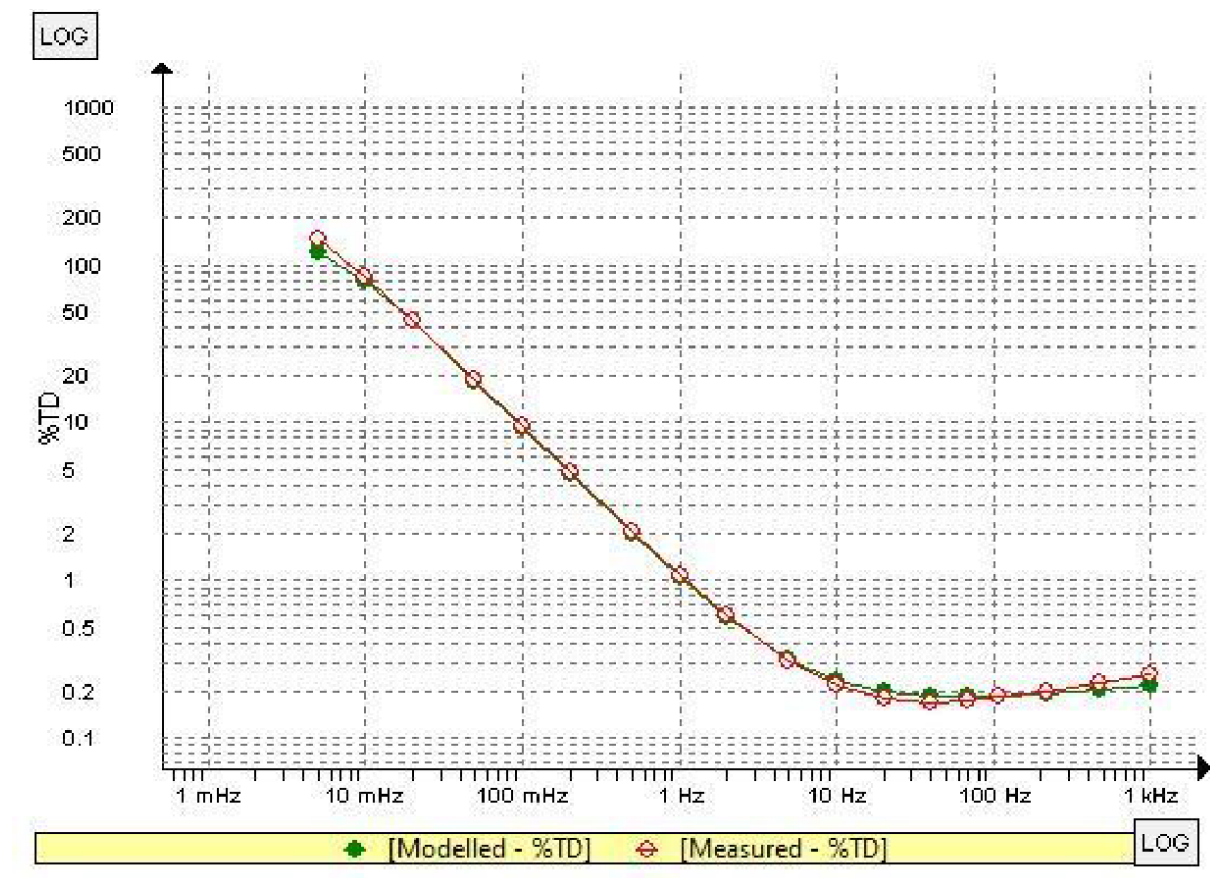
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.291	1.9	0.007
< 0.30 % As new	< 1.0 % As new	< 0.0060 % As new
0.30 - 0.50 % Good	1.0 - 2.0 % Dry	0.0060 - 0.060 % Good
0.50 - 1.0 % Deteriorated	2.0 - 3.0 % Moderately wet	0.060 - 0.60 % Service aged
> 1.0 % Investigate	> 3.0 % Wet	> 0.60 % Deteriorated



Insulation assessment(CHL)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CHL	140	50	4254	0.172	0.206

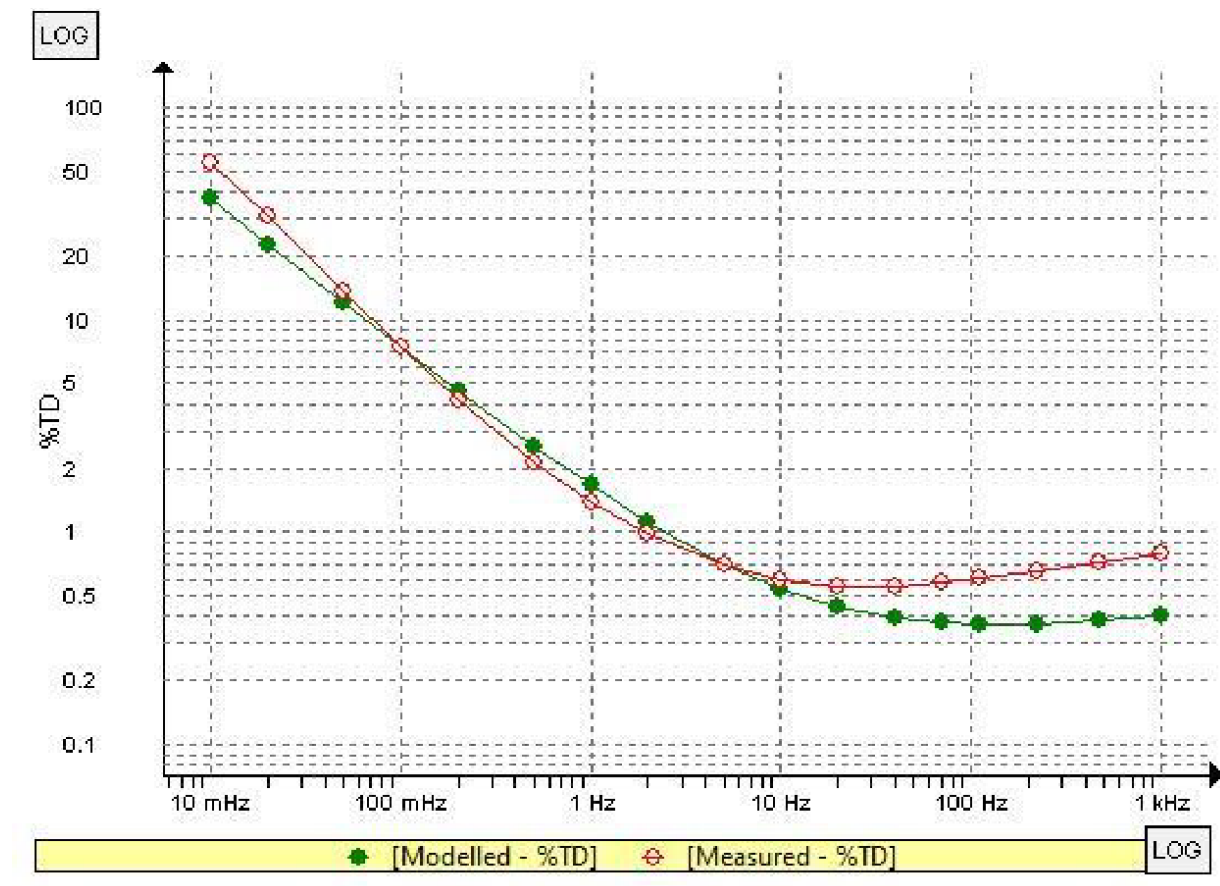
Analysis results		
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.206	0.2	0.012
< 0.30 % As new	< 1.0 % As new	< 0.0060 % As new
0.30 - 0.50 % Good	1.0 - 2.0 % Dry	0.0060 - 0.060 % Good
0.50 - 1.0 % Deteriorated	2.0 - 3.0 % Moderately wet	0.060 - 0.60 % Service aged
> 1.0 % Investigate	> 3.0 % Wet	> 0.60 % Deteriorated



Insulation assessment(CLG)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CLG	140	50	5826	0.561	0.587

Analysis results		
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.587	1.2	0.003
< 0.30 % As new	< 1.0 % As new	< 0.0060 % As new
0.30 - 0.50 % Good	1.0 - 2.0 % Dry	0.0060 - 0.060 % Good
0.50 - 1.0 % Deteriorated	2.0 - 3.0 % Moderately wet	0.060 - 0.60 % Service aged
> 1.0 % Investigate	> 3.0 % Wet	> 0.60 % Deteriorated



MINIPPUKELIANINTANAFTER 2023-08-31 10.59

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CHG - (31/8/2023 8:42:00 AM)

Test Mode	Hum (50Hz)	Offset	Capacitance (930Hz, 140 (RMS))
UST-R	423 pA	-1.0 nA	4.2 nF
UST-B	---	---	---
UST-RB	423 pA*	-1.0 nA*	4.2 nF*
GST-G	423 pA*	2.1 nA*	5.5 nF
GSTg-R	54 fA*	1.0 nA*	1.2 nF*
GSTg-B	-423 pA*	2.1 nA*	5.5 nF*
GSTg-RB	54 fA	1.0 nA	1.2 nF

* Estimated from measurements of other Test Modes

Hum current is peak value of the fundamental

1000	1.22029E-09	3.52523E-12	0.288886	0.288885
470	1.22166E-09	3.42409E-12	0.280283	0.280282
220	1.22319E-09	3.49078E-12	0.285383	0.285382
110	1.22464E-09	3.81831E-12	0.311791	0.31179
70	1.2256E-09	4.18445E-12	0.34142	0.341418
40	1.2283E-09	4.88775E-12	0.397929	0.397926
20	1.23022E-09	6.2122E-12	0.504969	0.504962
10	1.23256E-09	8.42679E-12	0.683683	0.683667
5	1.23563E-09	1.20149E-11	0.972368	0.972322
2	1.24007E-09	2.00169E-11	1.61418	1.61397

1	1.24659E-09	3.03465E-11	2.43436	2.43363
0.5	1.26043E-09	4.49989E-11	3.57012	3.56785
0.2	1.2727E-09	9.15427E-11	7.19279	7.17426
0.1	1.28681E-09	1.6004E-10	12.437	12.3419
0.05	1.30582E-09	2.83548E-10	21.7141	21.2196
0.02	1.35282E-09	6.48978E-10	47.9723	43.2528
0.01	1.44319E-09	1.23128E-09	85.3163	64.9044

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CHL - (31/8/2023 8:32:50 AM)

Test Mode	Hum (50Hz)	Offset	Capacitance (930Hz, 140 (RMS))
UST-R	6.2 nA	-866 pA	4.2 nF
UST-B	---	---	---
UST-RB	6.2 nA*	-866 pA*	4.2 nF*
GST-G	2.9 nA*	7.1 nA*	5.5 nF
GSTg-R	9.1 nA*	6.3 nA*	1.2 nF*
GSTg-B	2.9 nA*	7.1 nA*	5.5 nF*
GSTg-RB	9.1 nA	6.3 nA	1.2 nF

* Estimated from measurements of other Test Modes

Hum current is peak value of the fundamental

1000	4.24103E-09	1.07854E-11	0.254311	0.25431
470	4.24363E-09	9.50047E-12	0.223876	0.223876
220	4.24735E-09	8.42206E-12	0.19829	0.198289
110	4.25074E-09	7.73236E-12	0.181906	0.181906
70	4.25281E-09	7.40742E-12	0.174177	0.174177

40	4.2552E-09	7.23373E-12	0.169998	0.169997
20	4.25767E-09	7.60515E-12	0.178622	0.178622
10	4.26473E-09	9.31604E-12	0.218444	0.218443
5	4.26703E-09	1.32787E-11	0.311192	0.311191
2	4.27003E-09	2.57198E-11	0.602332	0.602321
1	4.26689E-09	4.65047E-11	1.0899	1.08983
0.5	4.27054E-09	8.75265E-11	2.04954	2.04911
0.2	4.27784E-09	2.0822E-10	4.86741	4.86166
0.1	4.28965E-09	4.05842E-10	9.46095	9.41889
0.05	4.31024E-09	7.94227E-10	18.4265	18.1214
0.02	4.38577E-09	1.9417E-09	44.2728	40.4827
0.01	4.54883E-09	3.78169E-09	83.1356	63.9286
0.005	5.01717E-09	7.23157E-09	144.136	82.1623

=====

CLG - (31/8/2023 8:47:46 AM)

Test Mode	Hum (50Hz)	Offset	Capacitance (930Hz, 140 (RMS))
UST-R	1.1 nA	-990 pA	4.2 nF
UST-B	---	---	---
UST-RB	1.1 nA*	-990 pA*	4.2 nF*
GST-G	1.1 nA*	2.0 nA*	10 nF
GSTg-R	4.5 fA*	1.0 nA*	5.8 nF*
GSTg-B	-1.1 nA*	2.0 nA*	10 nF*
GSTg-RB	4.5 fA	1.0 nA	5.8 nF

* Estimated from measurements of other Test Modes

Hum current is peak value of the fundamental

1000	5.76031E-09	4.51913E-11	0.784529	0.784504
470	5.78016E-09	4.20048E-11	0.726706	0.726687
220	5.79837E-09	3.81812E-11	0.658481	0.658466
110	5.8124E-09	3.50404E-11	0.602856	0.602845
70	5.82041E-09	3.34361E-11	0.574464	0.574454
40	5.8295E-09	3.22143E-11	0.552609	0.5526
20	5.83943E-09	3.22082E-11	0.551563	0.551555
10	5.84887E-09	3.47851E-11	0.594733	0.594722
5	5.8656E-09	4.1009E-11	0.699146	0.699128
2	5.8805E-09	5.7418E-11	0.976413	0.976366
1	5.89358E-09	8.20436E-11	1.39208	1.39195
0.5	5.90194E-09	1.26297E-10	2.13992	2.13943
0.2	5.931E-09	2.487E-10	4.19322	4.18954
0.1	5.96061E-09	4.42435E-10	7.42265	7.40228
0.05	6.0075E-09	8.21001E-10	13.6663	13.5404
0.02	6.1583E-09	1.89805E-09	30.8211	29.4538
0.01	6.5316E-09	3.60322E-09	55.1659	48.3034



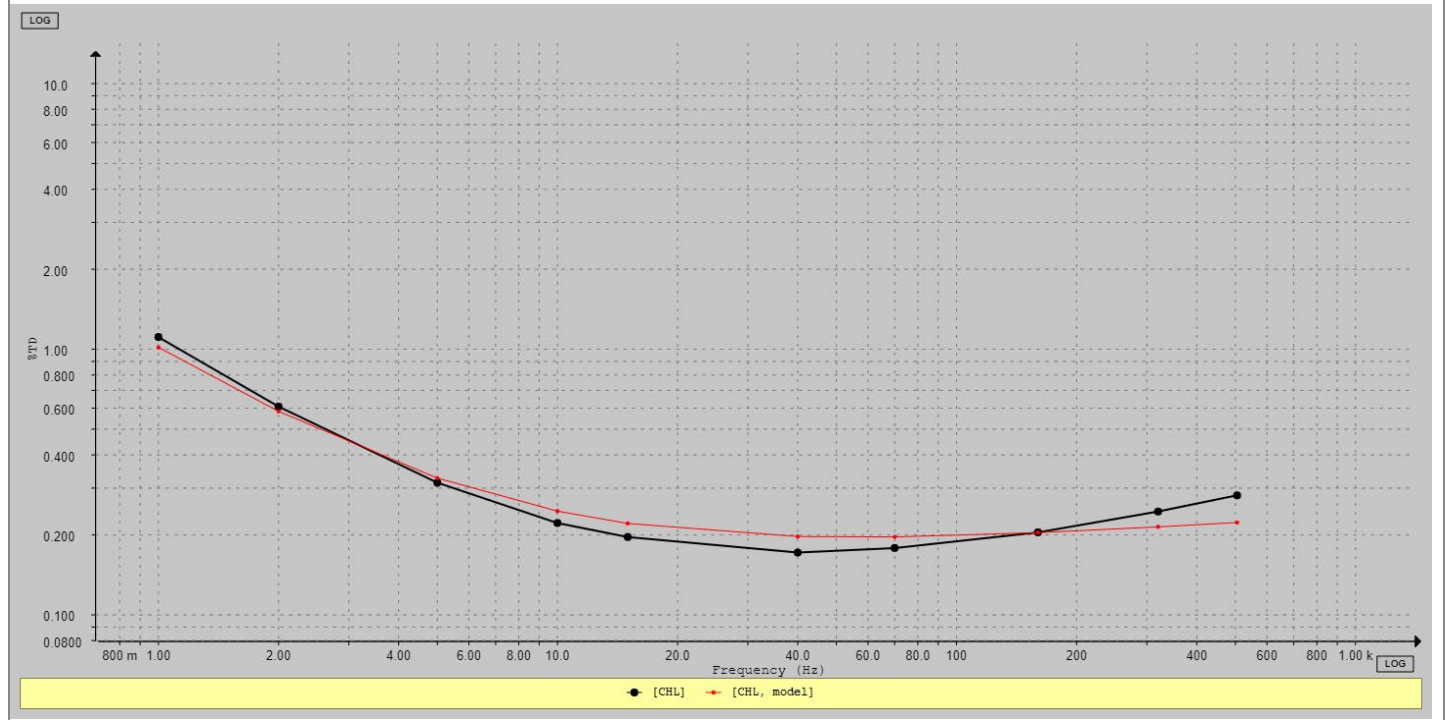
TRANSFORMER TANDELTA TEST REPORT

*SPAJ Electrical
Engineering (M) Sdn. Bhd.*



Tan Delta - Power Transformer

Designation	Test Mode	f (Hz)	U	I eq	C	%TD at 40 °C	ITC2 Corr. Factor	Corr. %TD to 20°C	P eq at 40 °C	% VDF	ITC2
CHG + CHL	GST-GND	50.00	10.00 kV	17.18 mA	5.470 nF	0.230	1.154	0.266	396.0 mW	0.01 %	
CHG	GSTg-RB	50.00	10.00 kV	3.842 mA	1.223 nF	0.413	1.154	0.477	158.8 mW	0.03 %	
CHL	UST-R	50.00	10.00 kV	13.34 mA	4.246 nF	0.178	1.154	0.205	237.0 mW	0.01 %	●
CLG + CLH	GST-GND	50.00	6.002 kV	26.14 mA	8.320 nF	0.242	1.154	0.279	631.9 mW	0.01 %	
CLG	GSTg-RB	50.00	6.002 kV	12.80 mA	4.073 nF	0.308	1.154	0.355	394.0 mW	0.02 %	
CLH	UST-R	50.00	6.003 kV	13.34 mA	4.247 nF	0.178	1.154	0.205	237.2 mW	0.01 %	
CHG + CLG (optional)	GST-GND	---	--- V	--- A	--- F	---	---	---	--- W	---	
CHL'	Calculated	---	--- V	13.34 mA	4.247 nF	---	---	---	237.2 mW	---	
CLH'	Calculated	---	--- V	13.34 mA	4.247 nF	---	---	---	237.9 mW	---	
CHG-C1'	Calculated	---	--- V	--- A	--- F	---	---	---	--- W	---	
CLG-C1'	Calculated	---	--- V	--- A	--- F	---	---	---	--- W	---	
CHG + CLG	Calculated	---	--- V	16.64 mA	5.296 nF	---	---	---	552.8 mW	---	



Comment:



TRANSFORMER EXCITATION 10KV TEST REPORT

*SPAJ Electrical
Engineering (M) Sdn. Bhd.*

Tan Delta - Power Transformer Excitation							
Connection	Tap	Tap Voltage (V)	f (Hz)	U	I eq	L	P eq at 32 °C
A-B	1	34 650	50.00	9.996 kV	24.20 mA	2.401 kH	202.4 W
B-C	1	34 650	50.00	10.01 kV	9.177 mA	8.352 kH	83.48 W
C-A	1	34 650	50.00	9.997 kV	23.74 mA	2.589 kH	203.1 W
A-B	2	33 825	50.00	10.01 kV	25.01 mA	2.335 kH	209.6 W
B-C	2	33 825	50.00	9.994 kV	9.542 mA	8.195 kH	87.16 W
C-A	2	33 825	50.00	10.01 kV	24.65 mA	2.511 kH	211.4 W
A-B	3	33 000	50.00	10.01 kV	25.96 mA	2.265 kH	218.2 W
B-C	3	33 000	50.00	10.01 kV	9.926 mA	8.072 kH	91.09 W
C-A	3	33 000	50.00	10.00 kV	25.64 mA	2.433 kH	220.6 W
A-B	4	32 175	50.00	10.00 kV	26.97 mA	2.196 kH	227.5 W
B-C	4	32 175	50.00	10.00 kV	10.35 mA	7.930 kH	95.40 W
C-A	4	32 175	50.00	9.999 kV	26.69 mA	2.359 kH	230.3 W
A-B	5	31 350	50.00	10.01 kV	28.05 mA	2.133 kH	237.5 W
B-C	5	31 350	50.00	10.00 kV	10.84 mA	7.775 kH	100.4 W
C-A	5	31 350	50.00	10.01 kV	27.83 mA	2.284 kH	240.9 W
Comment:							



TRANSFORMER TURNS RATIO TEST REPORT

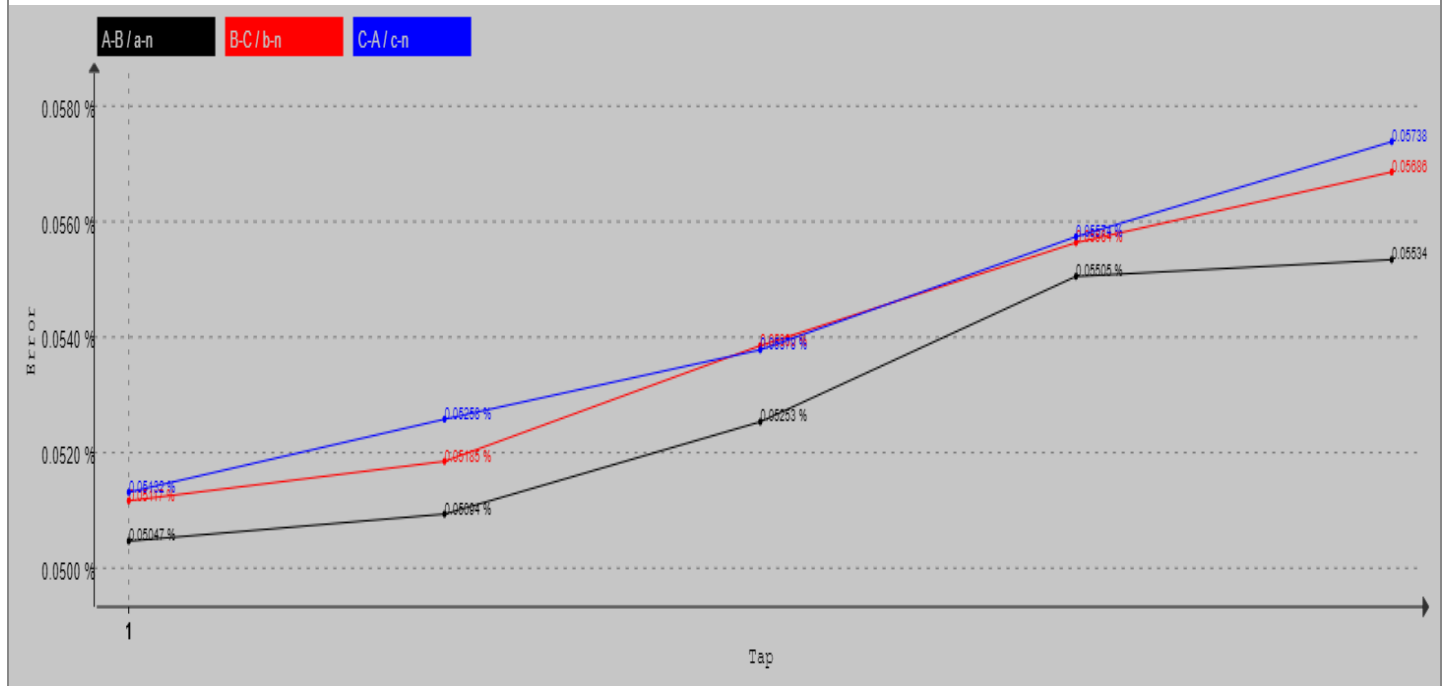
*SPAJ Electrical
Engineering (M) Sdn. Bhd.*



Turns ratio measurements

Connection	Tap (P)	Tap Voltage (V)	U	Test frequency	TTR	Measured TTR	Error	I Exc	Phase
A-B / a-n	1	34 650	250.1 V	50.00 Hz	5.456	5.459	0.05 %	1.673 mA	0.0 °
B-C / b-n	1	34 650	250.1 V	50.00 Hz	5.456	5.459	0.05 %	1.246 mA	0.0 °
C-A / c-n	1	34 650	250.1 V	50.00 Hz	5.456	5.459	0.05 %	1.645 mA	0.0 °
A-B / a-n	2	33 825	250.1 V	50.00 Hz	5.326	5.329	0.05 %	1.740 mA	0.0 °
B-C / b-n	2	33 825	250.1 V	50.00 Hz	5.326	5.329	0.05 %	1.297 mA	0.0 °
C-A / c-n	2	33 825	250.1 V	50.00 Hz	5.326	5.329	0.05 %	1.710 mA	0.0 °
A-B / a-n	3	33 000	250.1 V	50.00 Hz	5.196	5.199	0.05 %	1.801 mA	0.0 °
B-C / b-n	3	33 000	250.1 V	50.00 Hz	5.196	5.199	0.05 %	1.356 mA	0.0 °
C-A / c-n	3	33 000	250.1 V	50.00 Hz	5.196	5.199	0.05 %	1.781 mA	0.0 °
A-B / a-n	4	32 175	250.1 V	50.00 Hz	5.066	5.069	0.06 %	1.881 mA	0.0 °
B-C / b-n	4	32 175	250.1 V	50.00 Hz	5.066	5.069	0.06 %	1.414 mA	0.0 °
C-A / c-n	4	32 175	250.1 V	50.00 Hz	5.066	5.069	0.06 %	1.854 mA	0.0 °
A-B / a-n	5	31 350	250.1 V	50.00 Hz	4.936	4.939	0.06 %	1.965 mA	0.0 °
B-C / b-n	5	31 350	250.1 V	50.00 Hz	4.936	4.939	0.06 %	1.484 mA	0.0 °
C-A / c-n	5	31 350	250.1 V	50.00 Hz	4.936	4.939	0.06 %	1.929 mA	0.0 °

Comment:





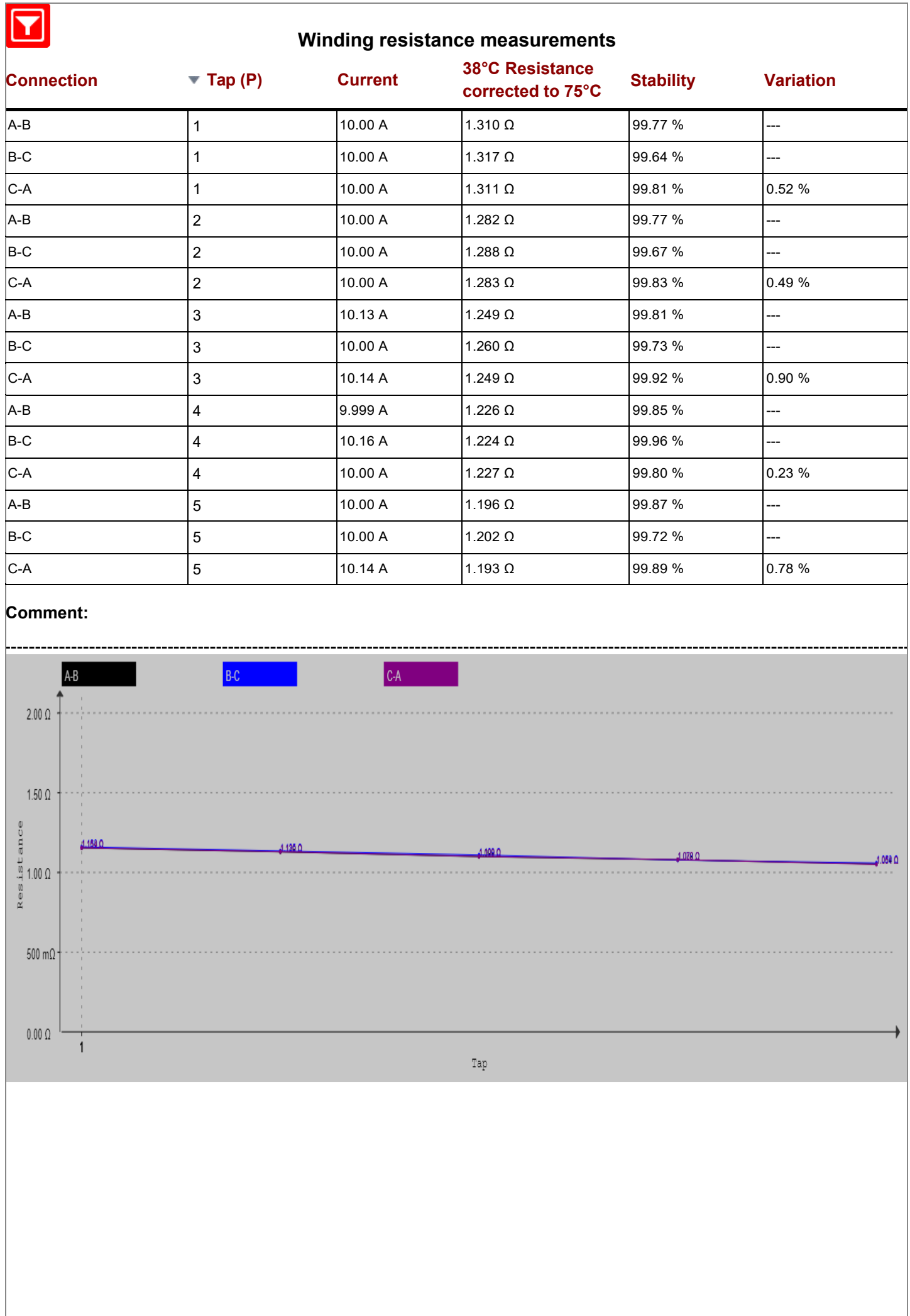
**SPAJ Electrical
Engineering (M) Sdn. Bhd.**

RECOGNIZED AND CERTIFIED USER OF **Megger**



TRANSFORMER DC WINDING RESISTANCE TEST REPORT

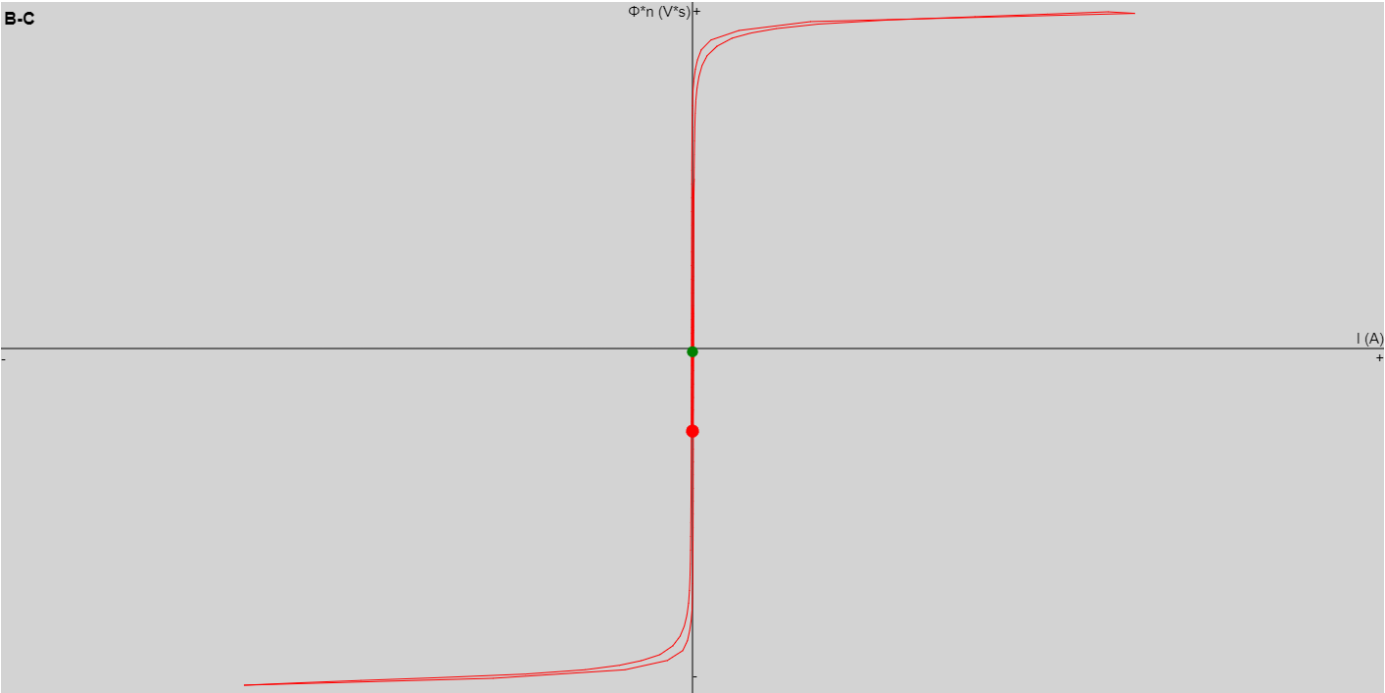
***SPAJ Electrical
Engineering (M) Sdn. Bhd.***





Demag measurements

Designation	Current	Time	Remanence before demag	Remanence after demag
B-C	0.000 A	41.57 s	24.64 %	1.116 %



Comment:



Winding resistance measurements

Connection	Tap (S)	Current	38°C Resistance corrected to 75°C	Stability	Variation
a-n	1	10.00 A	61.63 mΩ	99.73 %	---
b-n	1	9.997 A	61.83 mΩ	99.90 %	---
c-n	1	10.02 A	61.74 mΩ	99.99 %	0.32 %

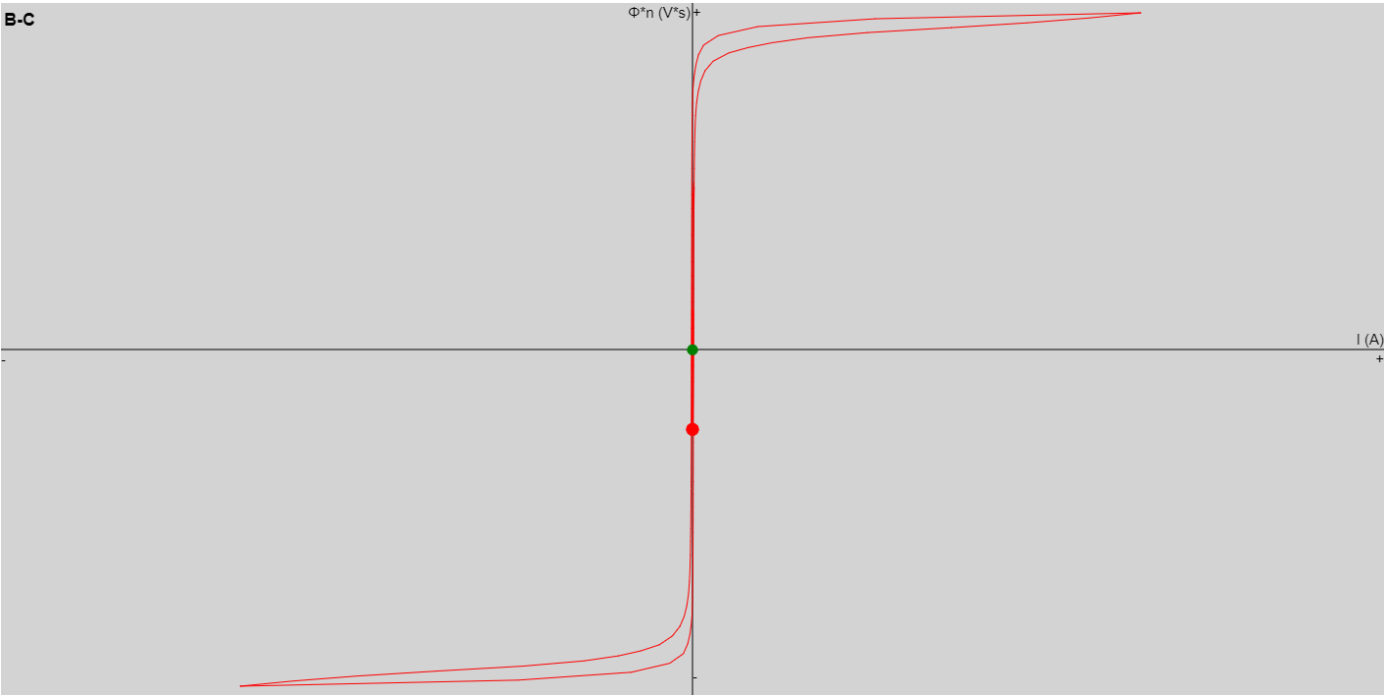
Comment:



Demag measurements

Designation	Current	Time	Remanence before demag	Remanence after demag
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B-C	0.000 A	39.74 s	23.73 %	<1 %
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Comment:



TRANSFORMER INSULATION RESISTANCE TEST REPORT

*SPAJ Electrical
Engineering (M) Sdn. Bhd.*



**SPAJ Electrical
Engineering (M) Sdn. Bhd.**

TEST CERTIFICATE
POWER TRANSFORMER TEST

RECOGNIZED AND CERTIFIED USER OF **Megger**

Client : TENAGA NASIONAL BERHAD	Main Contractor : MALAYSIA TRANSFORMER MANUFACTURING SDN BHD
Station : MPPU KELIAN INTAN	Manufacture year: 2013
Circuit : 33/11KV MTM TRANSFORMER :1	Serial No.: 5014
BAY ID: TX1	

INSULATION RESISTANCE & POLIRIZATION TEST

For Tr. Winding

1. 5kV Megger Insulation Reading

1) TNB Standards Insulation = 1 G OHMS

2) Polarization Index = (R 10 M/ R1M)

AFTER SERVICE:

MAINTANANCE :

TRANSFORMER INSULATION

1 Min Reading :

10 Min Reading:

Polarization

Index > 1.2

HV To E : 3640 MΩ

HV To E : 4520 MΩ

1.241758

LV To E : 3450 MΩ

LV To E : 4210 MΩ

1.22029

HV To LV: 3520 MΩ

HV To LV: 4350 MΩ

1.235795

NOTE: AMBIENT TEMPERATURE: 36 °C

OIL TEMPERATURE: 36 °C

TIME : 10.40 AM

Tested by:	Witnessed by:	Verified by :	ESE COMMENT:
Name: VICKNESH Dept: Tester	Name: Mr. FAKRUL Dept: TNB	Name: Dept:	
Date: 31/08/2023	Date: 31/08/2023	Date: 31/08/2023	