



TRANSFORMER TEST REPORT

BEFORE AND AFTER MAINTENANCE (MAJOR SERVICE & UN-TANK SERVICE)

Engineering (M) Sdn. Bhd.

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TRANSFORMER TESTING REPORTS

Location: PPU PENGKALAN HULU

Job: T2 BEFORE SERVICE

Date: 17/07/2024

TRANSFORMER NO	: 02
SERIAL NO	: P/320/07/15010
VOLTAGE	: 33000/11000
KVA	: 15000
MANUFACTURE	: MTM
YEAR	: 2008
TESTING DATE	: 17/07/2024

TEST PERFORMED

S.NO.	TITLE
1	SWEEP FREQUENCY RESPONSE ANALYSIS(SFRA)
2	FREQUENCY DOMAIN SPECTROSCOPY(FDS)
3	TANDELTA WINDING
4	EXCITATION CURRENT 10KV
5	TURN RATIO MEASUREMENT
6	DC WINDING RESISTANCE
7	OLTC DYNAMIC RESISTANCE
8	INSULATION RESISTANCE / POLARIZATION INDEX
9	TRANSFORMER CT RATIO,POLARITY & SATURATION
10	TRANSFORMER OTI,WTI CALIBRATION
11	TRANSFORMER AVR CALIBRATION
12	TRANSFORMER GUARD

TEST EQUIPMENT USED :

1. MEGGER FRAX 101
2. MEGGER IDAX 300
3. MEGGER TDX 120
4. MEGGER TRAX 220
5. MEGGER MIT515 INSULATION TESTER

TESTING PERFORMED BY:

1. VICKNESH A/L SUBRAMANIAM
2. GOBINATH RAJU
3. SAKTHI



TRANSFORMER SWEEP FREQUENCY RESPONSE ANALYSIS (FRAX) TEST REPORT

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

SFRA Test Results

Report date: 2024-07-17

Test date:

17/7/2024

Test time:

11:57:00

Company:

MTM

Substation

PPU PENGKALAN HULU T2

Designation:

PERAK

Manufacturer:

MTM

Serial number

P/320/07/15010

Year of manufacturing:

2008

Type:

15-201

Vector group:

Dyn11 (D-Y, 30° lead)

Voltage rating (kV):

33-11

Power rating (MVA):

15

Impedance (%):

9.9

Cooling:

ONAN/ONAF

OLTC extreme rise position

16

OLTC reg. winding out position:

1

DETC position:

Relative humidity:

65

Air temperature:

34

Object temperature:

48

Weather:

SUNNY

Tested by:

VICKNESH

Notes:

Designation: "PERAK" at "PPU PENGKALAN HULU T2"

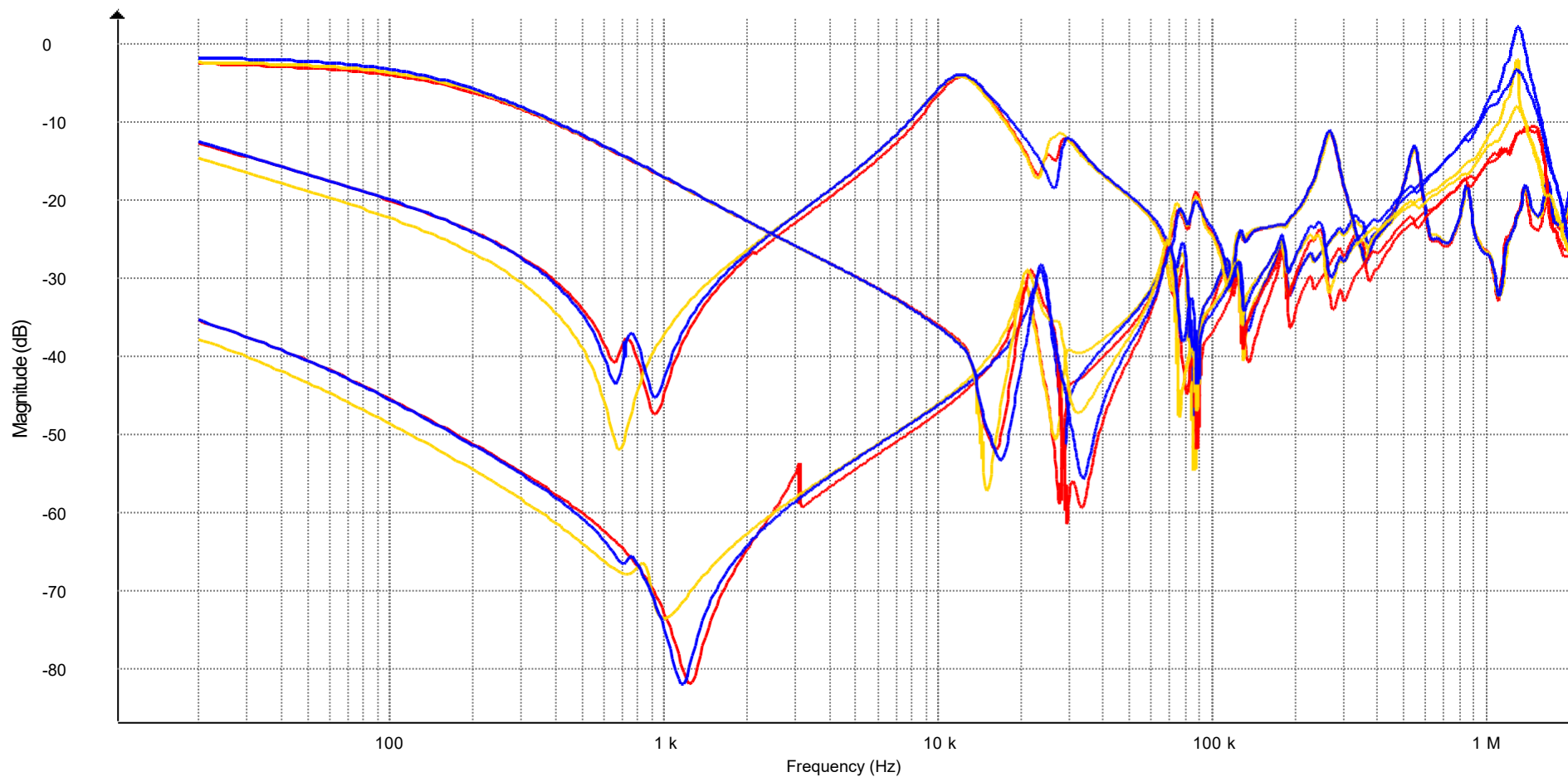
Serial Number: P/320/07/15010

Tested 17/7/2024 at 11:57:00

Manufacturer: MTM

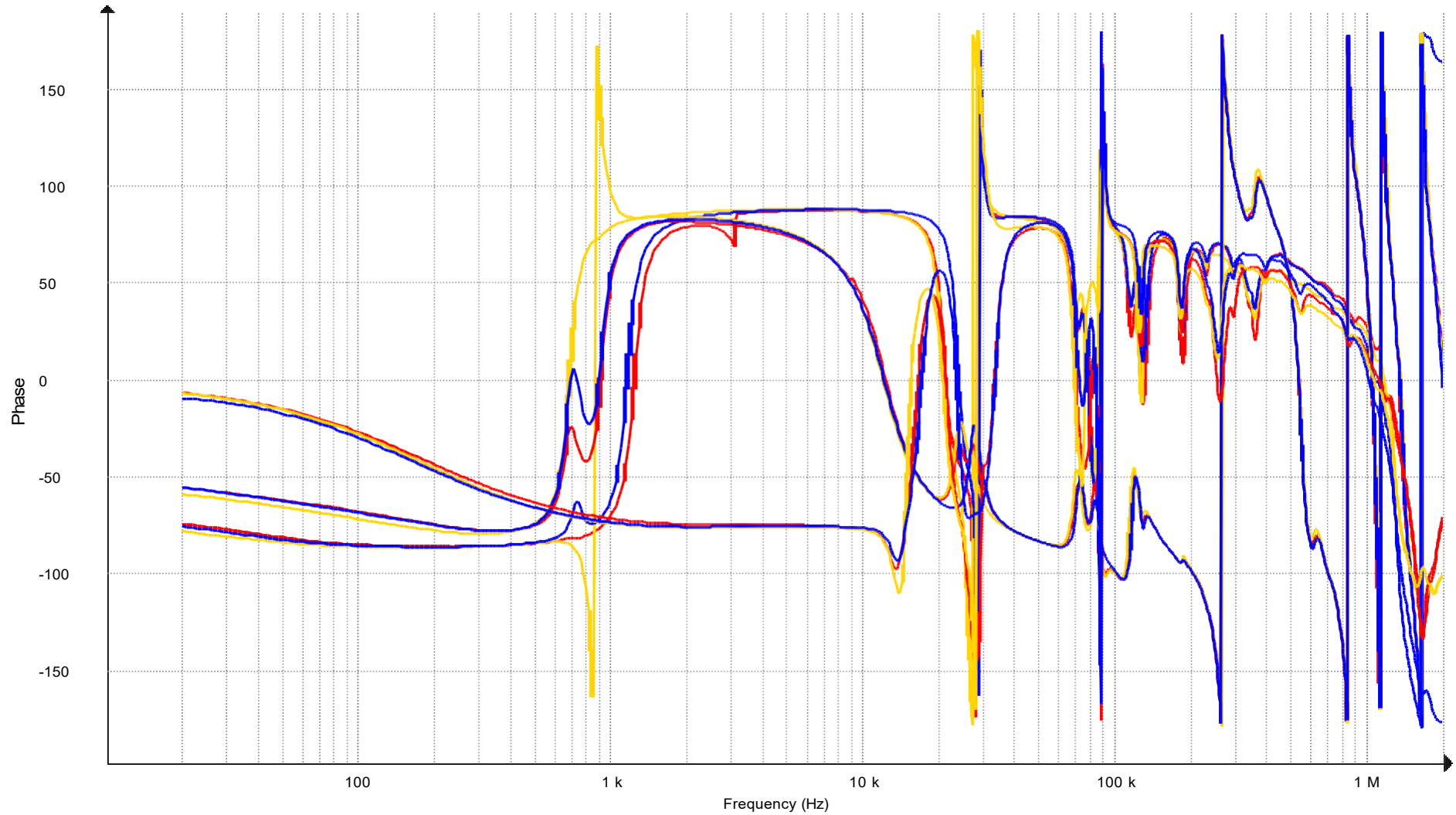
Tested by: VICKNESH

Magnitude:



[1u-1v [open, LTC=Max]] [1v-1w [open, LTC=Max]] [1w-1u [open, LTC=Max]] [2u-2n [open]] [2v-2n [open]] [2w-2n [open]]
[1u-1v [short 2u-2v-2w, LTC=Max]] [1v-1w [short 2u-2v-2w, LTC=Max]] [1w-1u [short 2u-2v-2w, LTC=Max]]

Phase:



[1u-1v [open, LTC=Max]] [1v-1w [open, LTC=Max]] [1w-1u [open, LTC=Max]] [2u-2n [open]] [2v-2n [open]] [2w-2n [open]]
[1u-1v [short 2u-2v-2w, LTC=Max]] [1v-1w [short 2u-2v-2w, LTC=Max]] [1w-1u [short 2u-2v-2w, LTC=Max]]

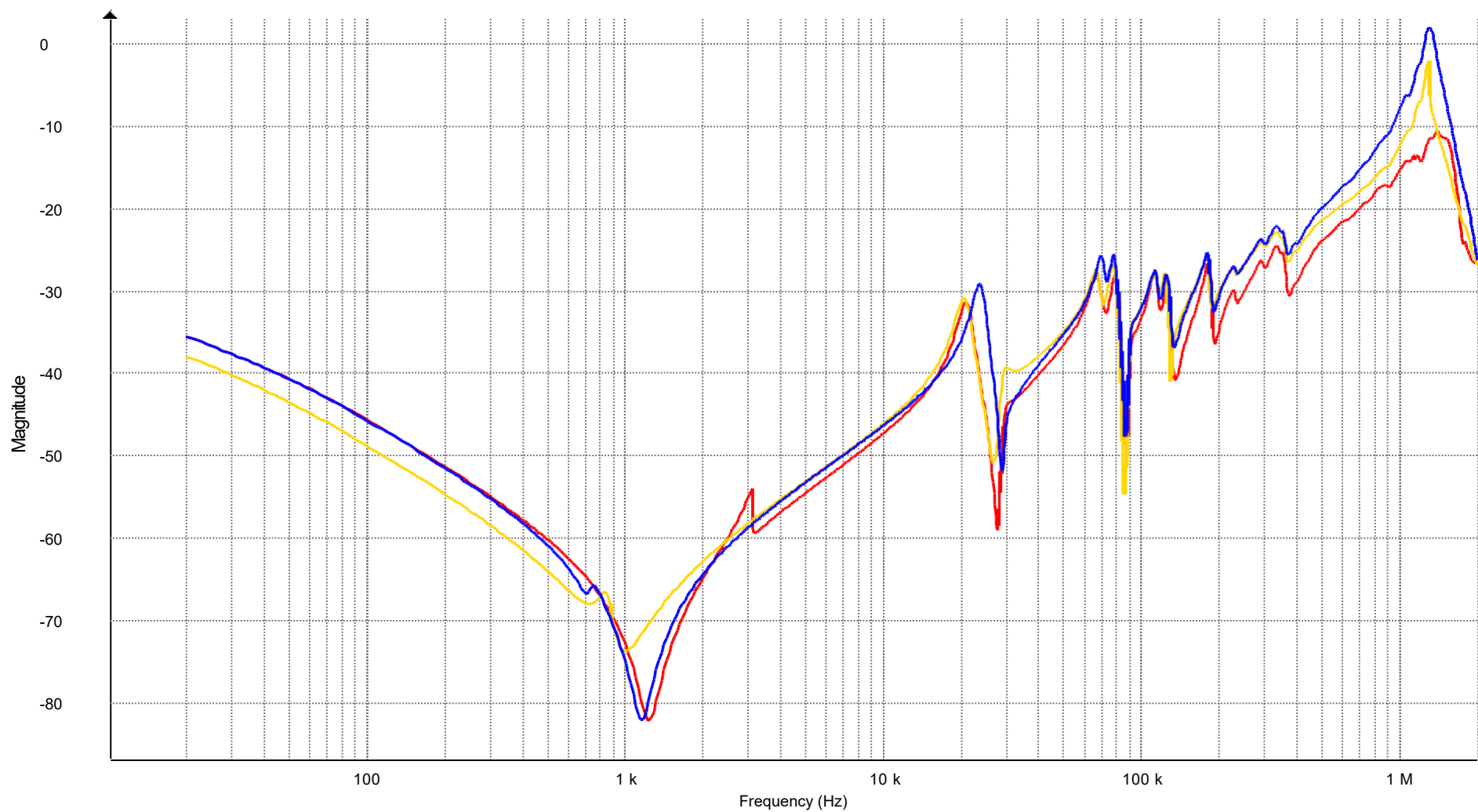
Designation: "PERAK" at "PPU PENGKALAN HULU T2"

Serial Number: P/320/07/15010

Manufacturer: MTM

Tested 17/7/2024 at 11:57:00

Tested by: VICKNESH



[1u-1v [open, LTC=Max]] [1v-1w [open, LTC=Max]] [1w-1u [open, LTC=Max]]

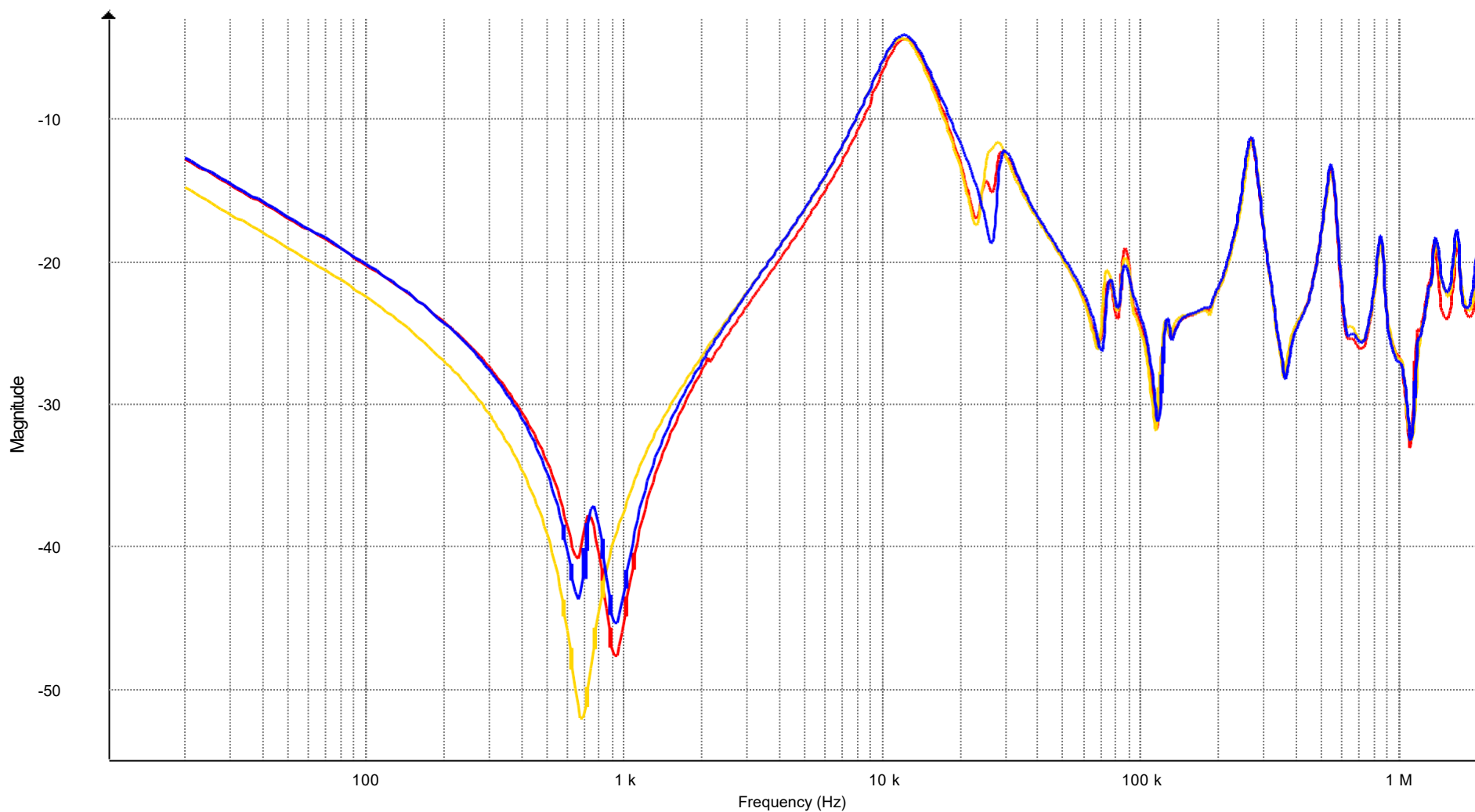
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Serial Number: P/320/07/15010

Manufacturer: MTM

Tested 17/7/2024 at 11:57:00

Tested by: VICKNESH



[2u-2n [open]]

[2v-2n [open]]

[2w-2n [open]]

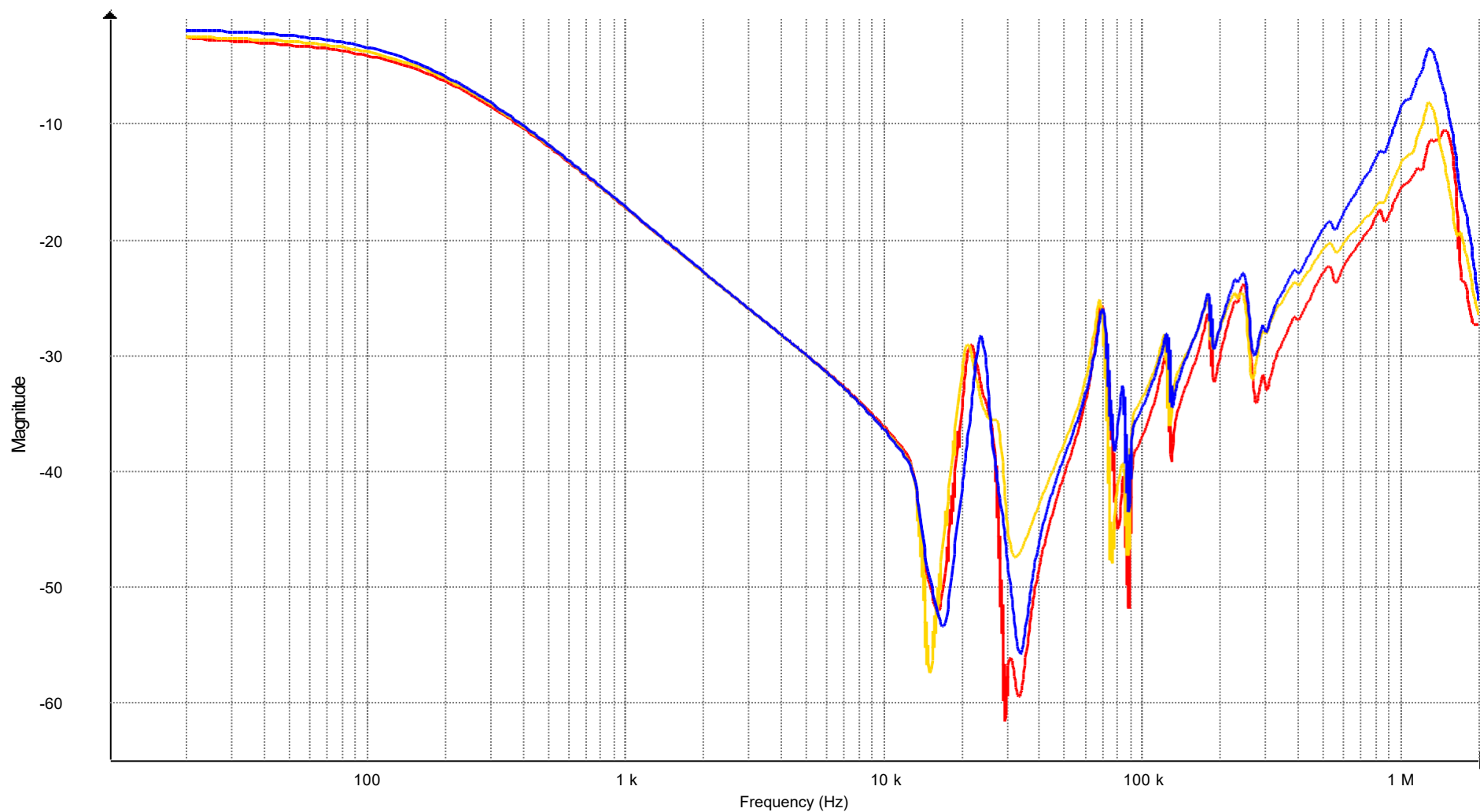
Designation: "PERAK" at "PPU PENGKALAN HULU T2"

Serial Number: P/320/07/15010

Manufacturer: MTM

Tested 17/7/2024 at 11:57:00

Tested by: VICKNESH



[1u-1v [short 2u-2v-2w, LTC=Max]]

[1v-1w [short 2u-2v-2w, LTC=Max]]

[1w-1u [short 2u-2v-2w, LTC=Max]]

DL/T 911-2004 Analyzer

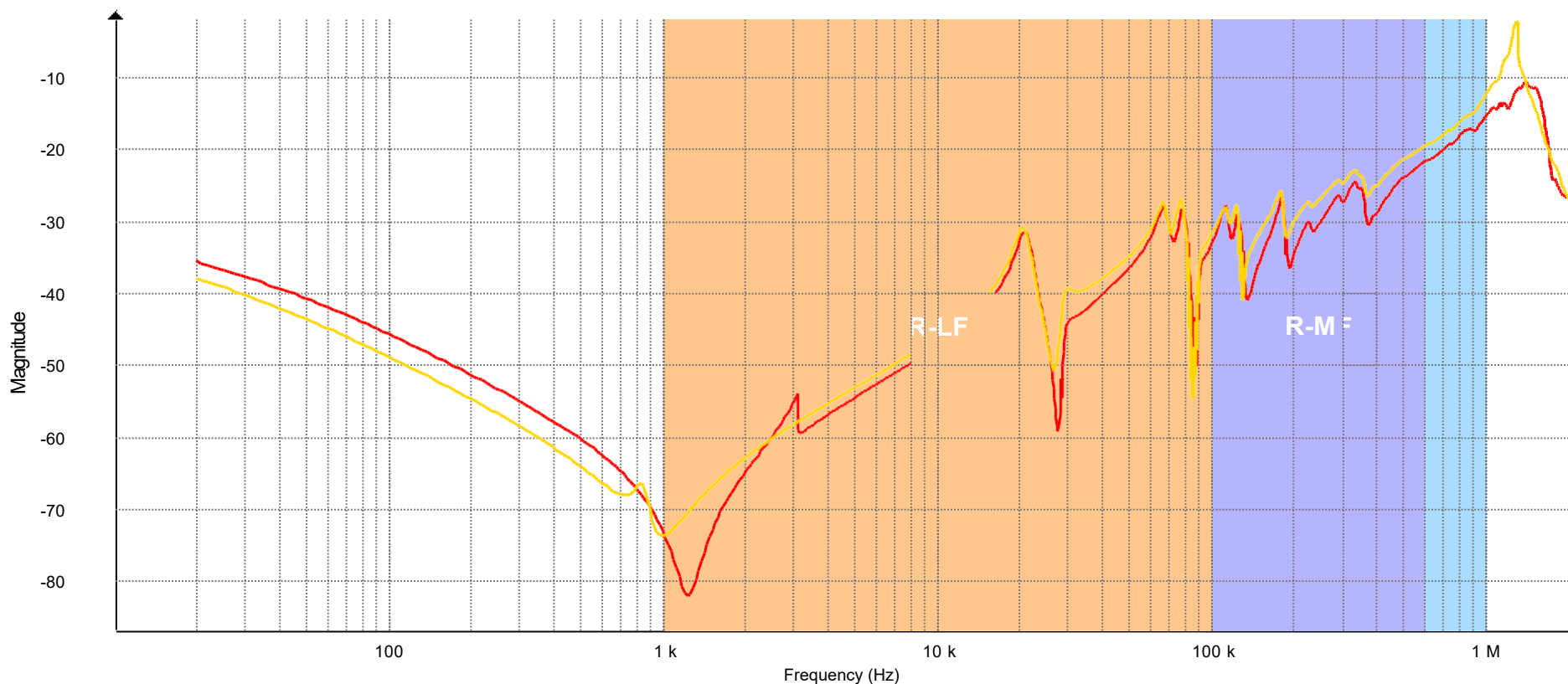
Designation: PERAK at PPU PENGKALAN HULU T2

Serial Number: P/320/07/15010

Tested 17/7/2024 at 11:57:00

Manufacturer: MTM

Tested by: VICKNESH



— [1u-1v [open, LTC=Max]] — [1v-1w [open, LTC=Max]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1u-1v [open, LTC=Max]] – [1v-1w [open, LTC=Max]]	1.65	1.16	1.95	Light Distortion
R ₂₃	[1v-1w [open, LTC=Max]] – [1w-1u [open, LTC=Max]]	1.32	1.52	3.49	Light Distortion
R ₃₁	[1w-1u [open, LTC=Max]] – [1u-1v [open, LTC=Max]]	1.47	1.49	1.96	Light Distortion

DL/T 911-2004 Analyzer**Designation:** PERAK at PPU PENGKALAN HULU T2**Serial Number:** P/320/07/15010**Tested** 17/7/2024 at 11:57:00**Manufacturer:** MTM**Tested by:** VICKNESH

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1v-1w [open, LTC=Max]] – [1w-1u [open, LTC=Max]]	1.32	1.52	3.49	Light Distortion
R ₂₃	[1w-1u [open, LTC=Max]] – [1u-1v [open, LTC=Max]]	1.47	1.49	1.96	Light Distortion
R ₃₁	[1u-1v [open, LTC=Max]] – [1v-1w [open, LTC=Max]]	1.65	1.16	1.95	Light Distortion

DL/T 911-2004 Analyzer

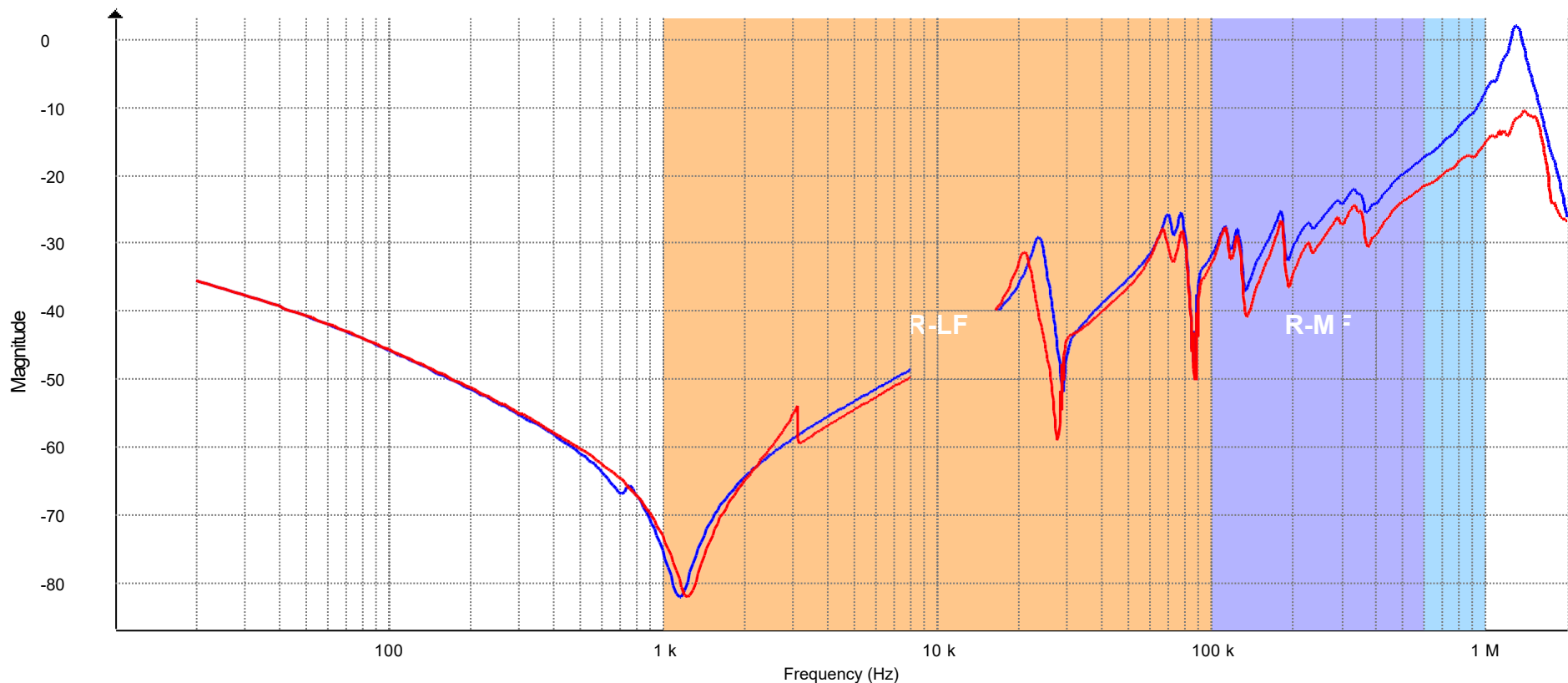
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Serial Number: P/320/07/15010

Tested 17/7/2024 at 11:57:00

Manufacturer: MTM

Tested by: VICKNESH



— [1w-1u [open, LTC=Max]] — [1u-1v [open, LTC=Max]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1w-1u [open, LTC=Max]] – [1u-1v [open, LTC=Max]]	1.47	1.49	1.96	Light Distortion
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DL/T 911-2004 Analyzer

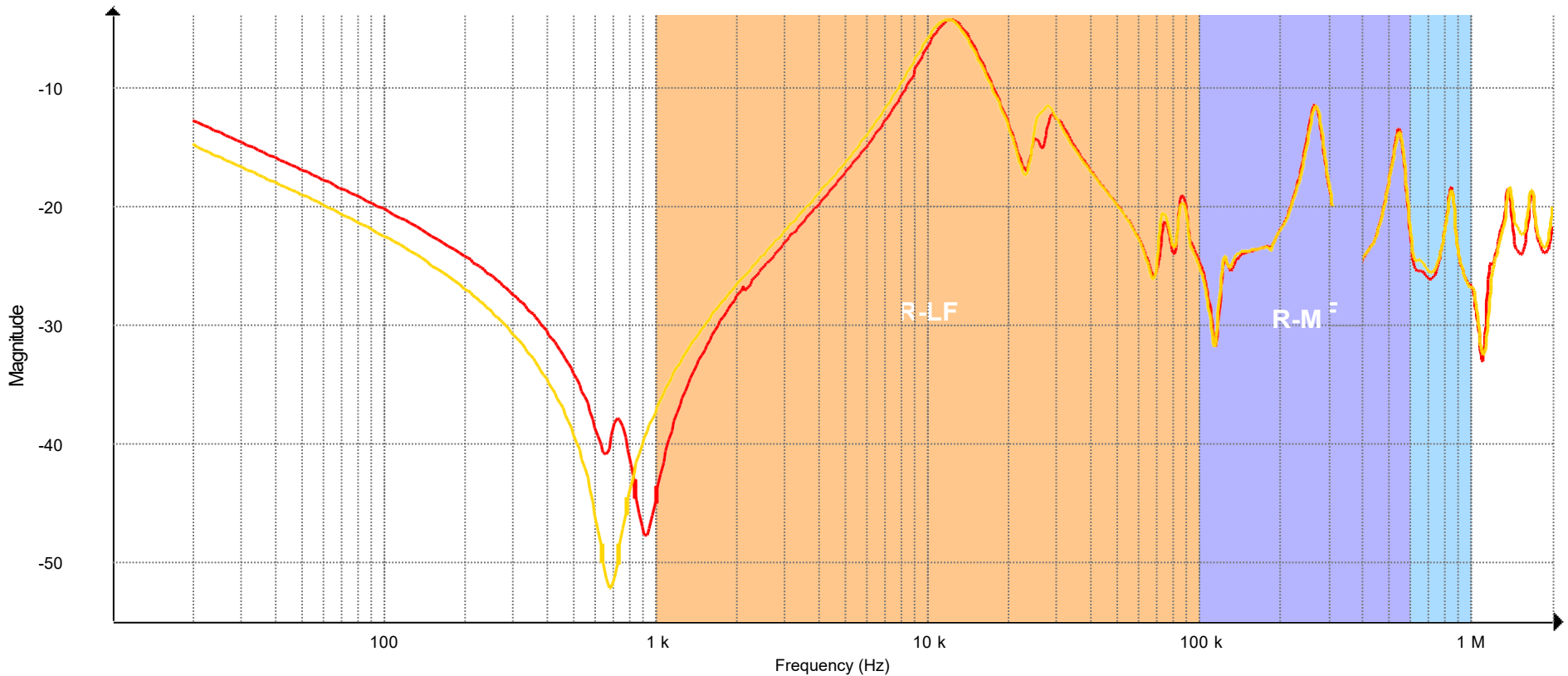
Designation: PERAK at PPU PENGKALAN HULU T2

Serial Number: P/320/07/15010

Tested 17/7/2024 at 11:57:00

Manufacturer: MTM

Tested by: VICKNESH



— [2u-2n [open]] — [2v-2n [open]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[2u-2n [open]] – [2v-2n [open]]	2.04	2.51	1.97	Normal
R ₂₃	[2v-2n [open]] – [2w-2n [open]]	1.71	2.04	2.27	Light Distortion
R ₃₁	[2w-2n [open]] – [2u-2n [open]]	2.09	2.55	1.99	Normal

DL/T 911-2004 Analyzer

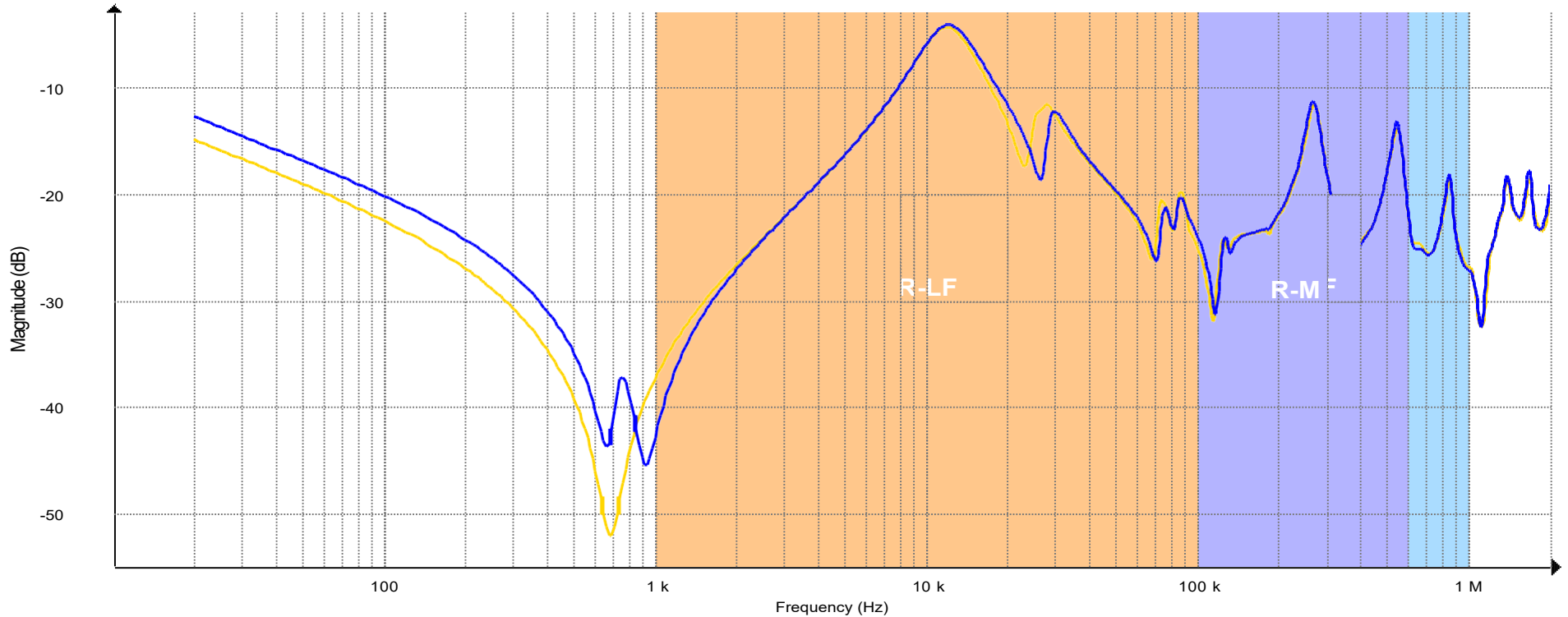
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Serial Number: P/320/07/15010

Tested 17/7/2024 at 11:57:00

Manufacturer: MTM

Tested by: VICKNESH



— [2v-2n [open]] — [2w-2n [open]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[2v-2n [open]] - [2w-2n [open]]	1.71	2.04	2.27	Light Distortion
R ₂₃	[2w-2n [open]] - [2u-2n [open]]	2.09	2.55	1.99	Normal
R ₃₁	[2u-2n [open]] - [2v-2n [open]]	2.04	2.51	1.97	Normal

DL/T 911-2004 Analyzer

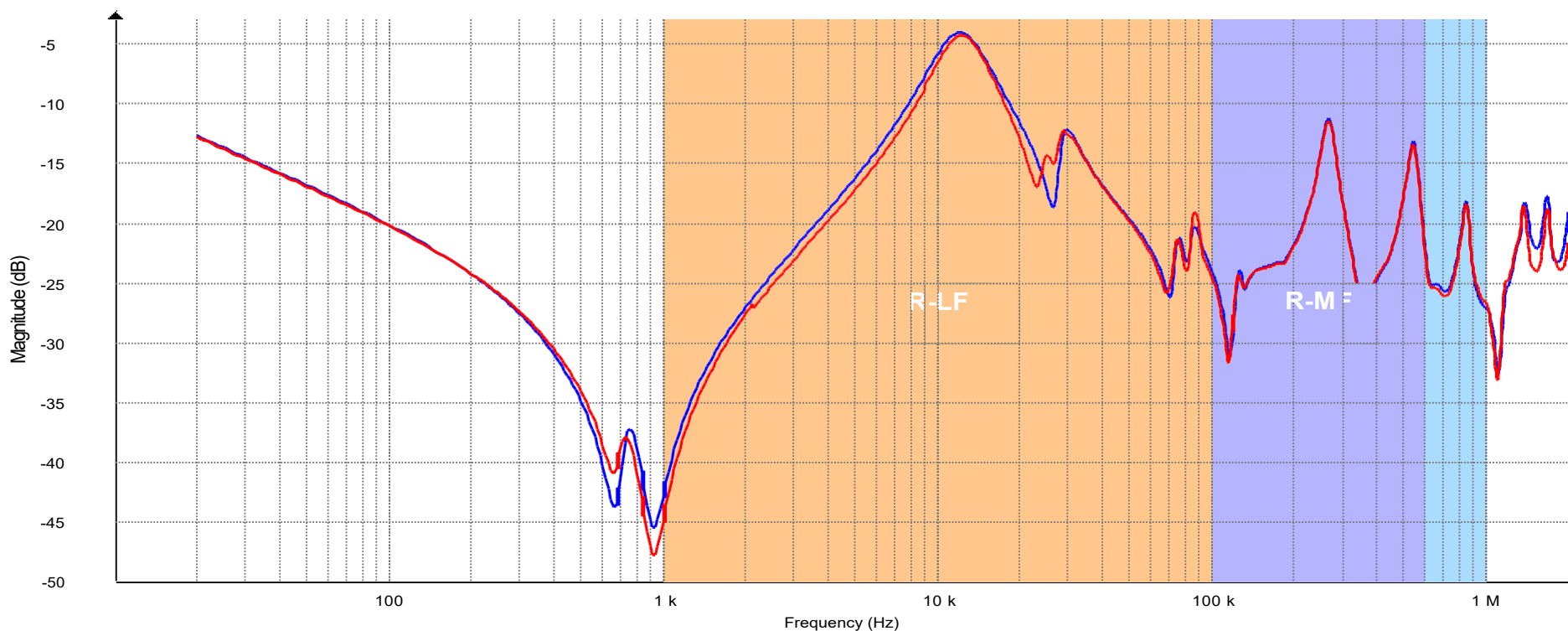
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Serial Number: P/320/07/15010

Tested 17/7/2024 at 11:57:00

Manufacturer: MTM

Tested by: VICKNESH



— [2w-2n [open]] — [2u-2n [open]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[2w-2n [open]] – [2u-2n [open]]	2.09	2.55	1.99	Normal
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DL/T 911-2004 Analyzer

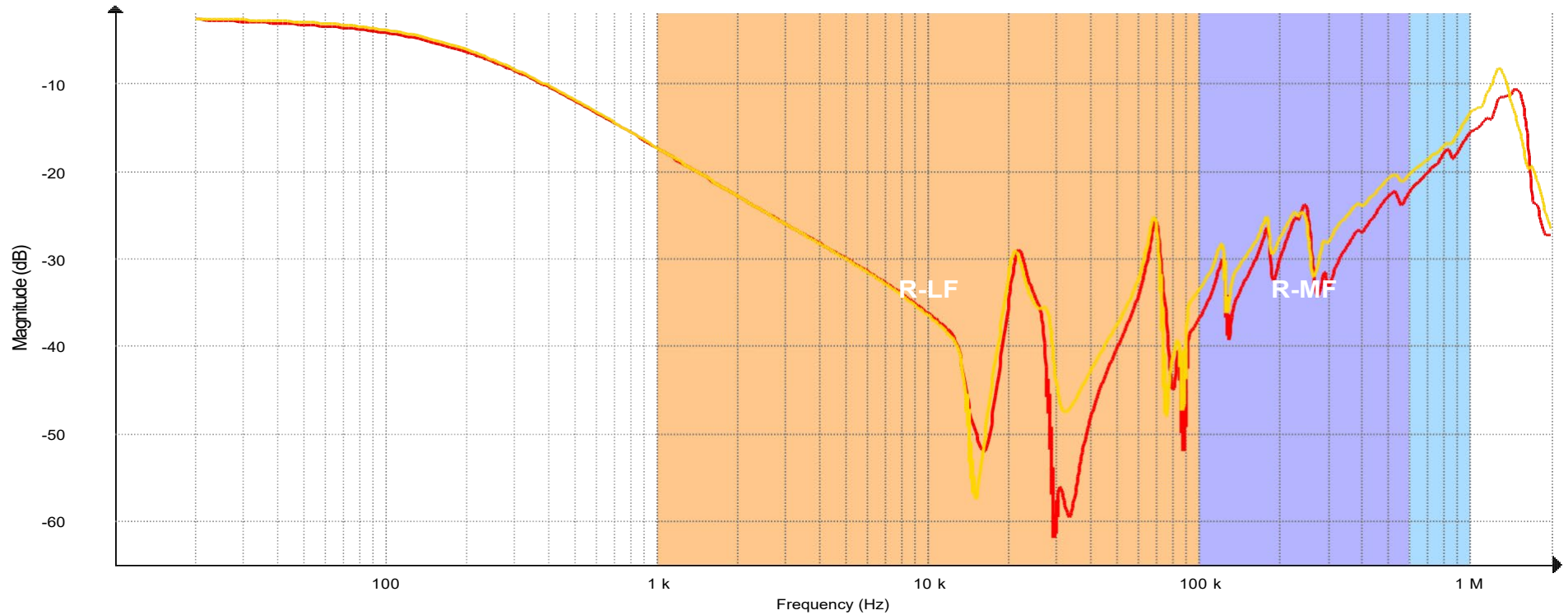
Designation: PERAK at PPU PENGKALAN HULU T2

Serial Number: P/320/07/15010

Tested 17/7/2024 at 11:57:00

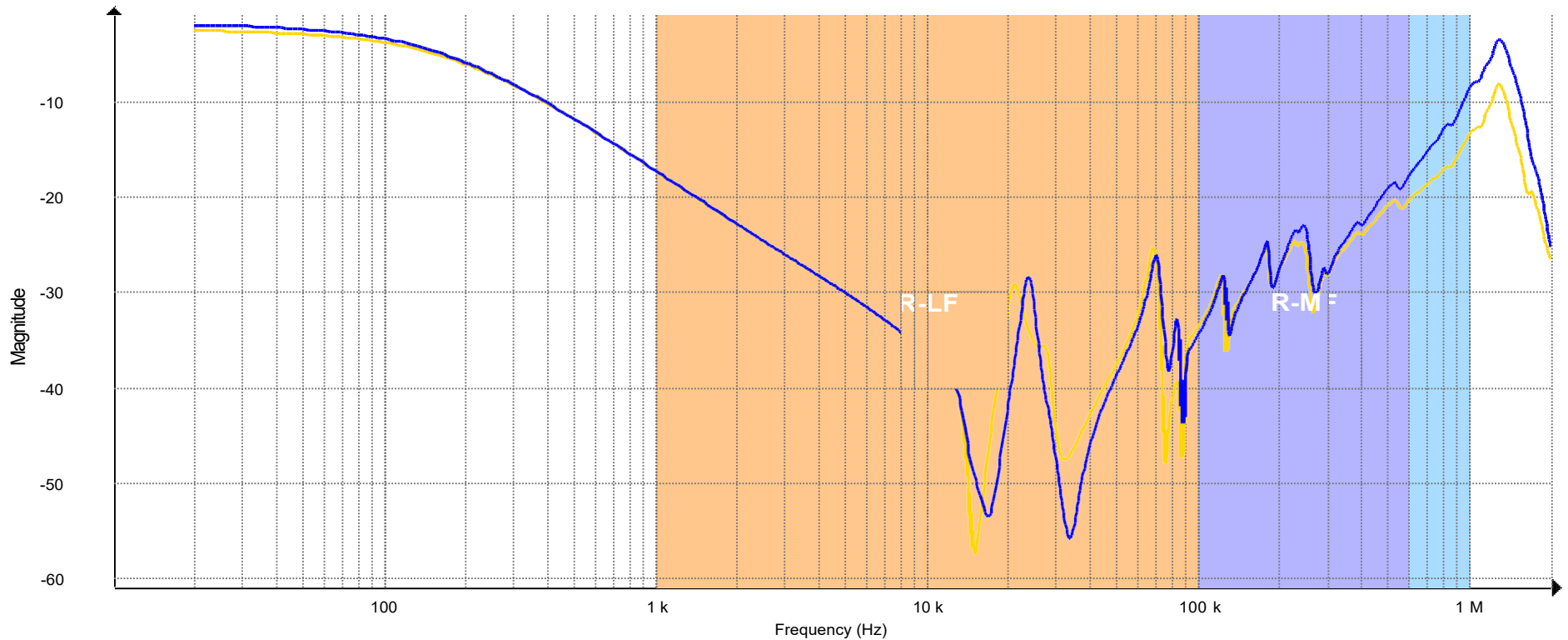
Manufacturer: MTM

Tested by: VICKNESH

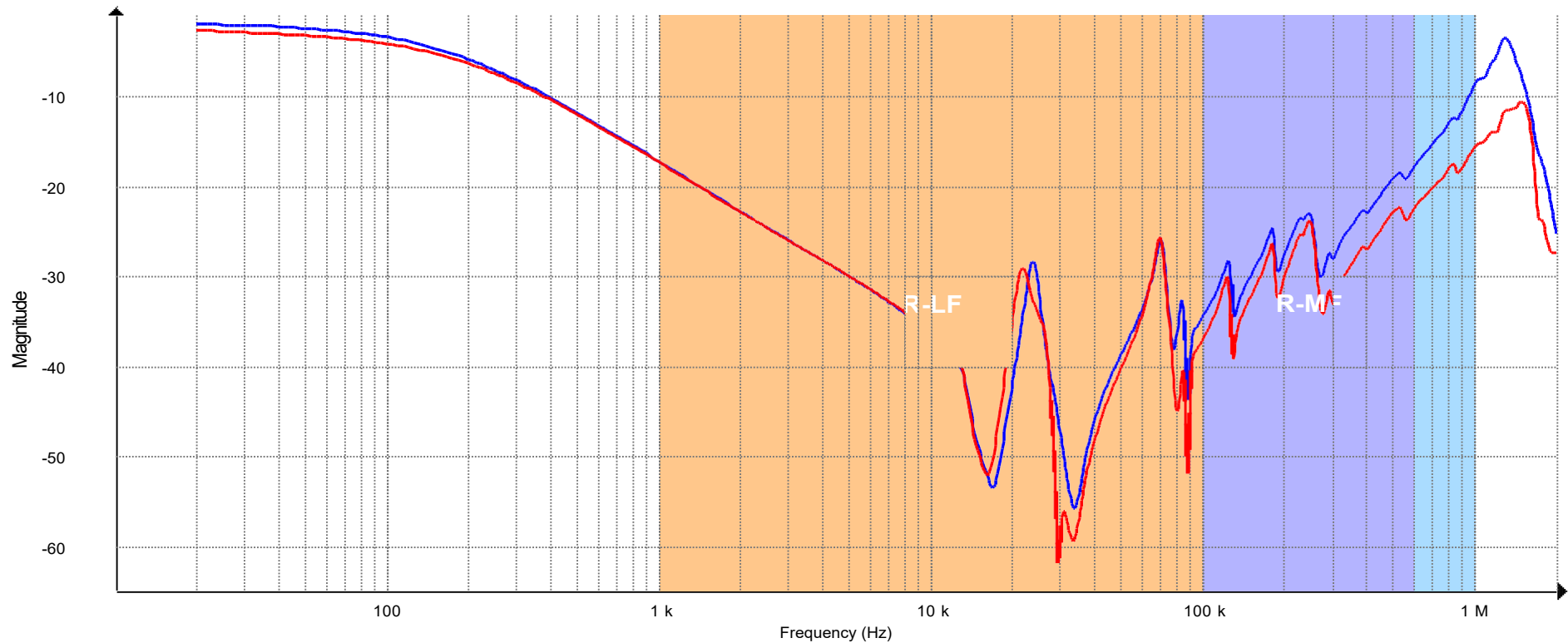


— [1u-1v [short 2u-2v-2w, LTC=Max]] [1v-1w [short 2u-2v-2w, LTC=Max]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1u-1v [short 2u-2v-2w, LTC=Max]] – [1v-1w [short 2u-2v-2w, LTC=Max]]	1.14	1.19	1.56	Light Distortion
R ₂₃	[1v-1w [short 2u-2v-2w, LTC=Max]] – [1w-1u [short 2u-2v-2w, LTC=Max]]	1.08	1.62	2.42	Light Distortion
R ₃₁	[1w-1u [short 2u-2v-2w, LTC=Max]] – [1u-1v [short 2u-2v-2w, LTC=Max]]	1.34	1.40	1.89	Light Distortion

DL/T 911-2004 Analyzer**Designation:** PERAK at PPU PENGKALAN HULU T2**Serial Number:** P/320/07/15010**Tested** 17/7/2024 at 11:57:00**Manufacturer:** MTM**Tested by:** VICKNESH

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1v-1w [short 2u-2v-2w, LTC=Max]] – [1w-1u [short 2u-2v-2w, LTC=Max]]	1.08	1.62	2.42	Light Distortion
R ₂₃	[1w-1u [short 2u-2v-2w, LTC=Max]] – [1u-1v [short 2u-2v-2w, LTC=Max]]	1.34	1.40	1.89	Light Distortion
R ₃₁	[1u-1v [short 2u-2v-2w, LTC=Max]] – [1v-1w [short 2u-2v-2w, LTC=Max]]	1.14	1.19	1.56	Light Distortion

DL/T 911-2004 Analyzer**Designation:** PERAK at PPU PENGKALAN HULU T2**Serial Number:** P/320/07/15010**Tested** 17/7/2024 at 11:57:00**Manufacturer:** MTM**Tested by:** VICKNESH

— [1w-1u [short 2u-2v-2w, LTC=Max]] — [1u-1v [short 2u-2v-2w, LTC=Max]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1w-1u [short 2u-2v-2w, LTC=Max]] – [1u-1v [short 2u-2v-2w, LTC=Max]]	1.34	1.40	1.89	Light Distortion
R ₂₃	[1u-1v [short 2u-2v-2w, LTC=Max]] – [1v-1w [short 2u-2v-2w, LTC=Max]]	1.14	1.19	1.56	Light Distortion
R ₃₁	[1v-1w [short 2u-2v-2w, LTC=Max]] – [1w-1u [short 2u-2v-2w, LTC=Max]]	1.08	1.62	2.42	Light Distortion



TRANSFORMER FREQUENCY DOMAIN SPECTROSCOPY (FDS) TEST REPORT

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

IDAX Measurement Report

General

Company:	MTM
Division:	PERAK
Location:	PPU PENGKALAN HULU T2 BEFORE
Date:	17/7/2024

Test conditions

Ambient temperature, °C:	34
Ambient %RH:	65
Object temperature, °C:	40
Weather:	SUNNY
Tester:	VICKNESH

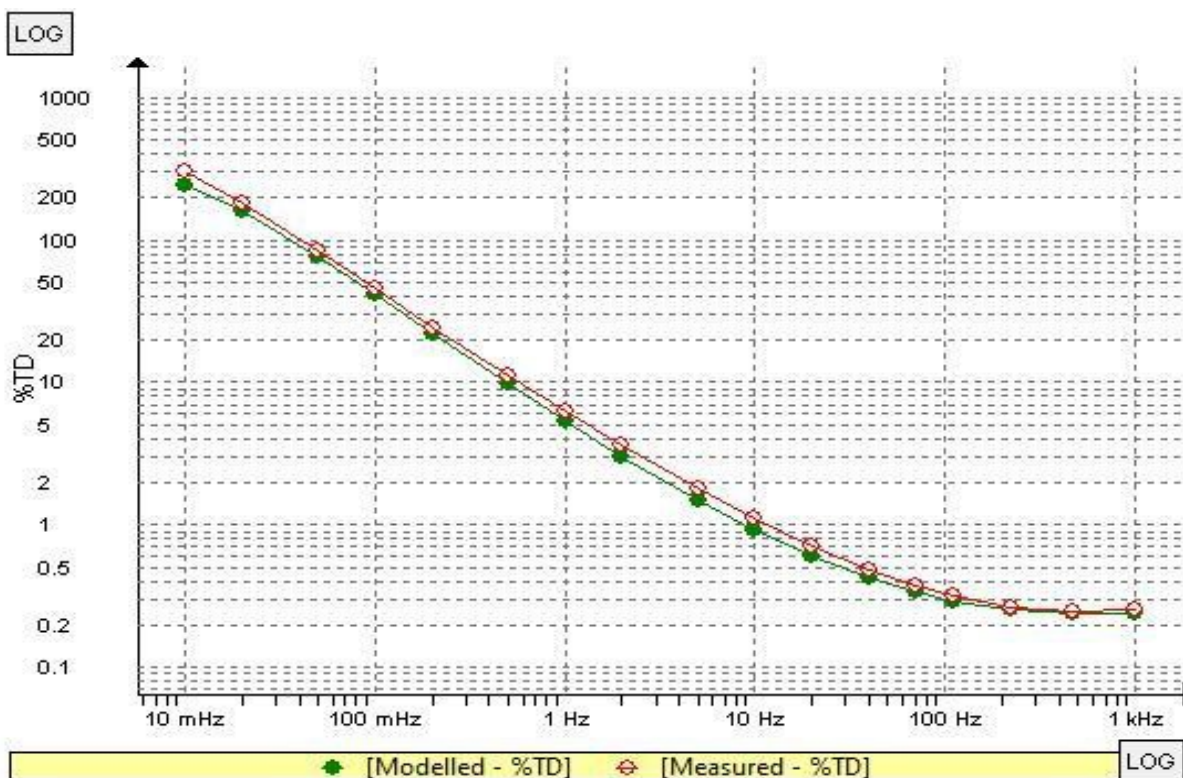
Test object information

Test object:	Two Winding Transformer
Designation:	PPU PENGKALAN HULU T1 BEFORE
Manufacturer:	MTM
Type:	15-201
Core type:	Core
Serial no:	P/320/07/15010
Coolant:	Mineral Oil
Cooling class:	ONAN/ONAF
Voltage (kV):	33/11
MVA:	15
Vector group:	DYN11
Frequency:	50

Insulation assessment(CHG)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CHG	140	50	2349	0.443	0.295

Analysis results		
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.295	2.4	0.047
< 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

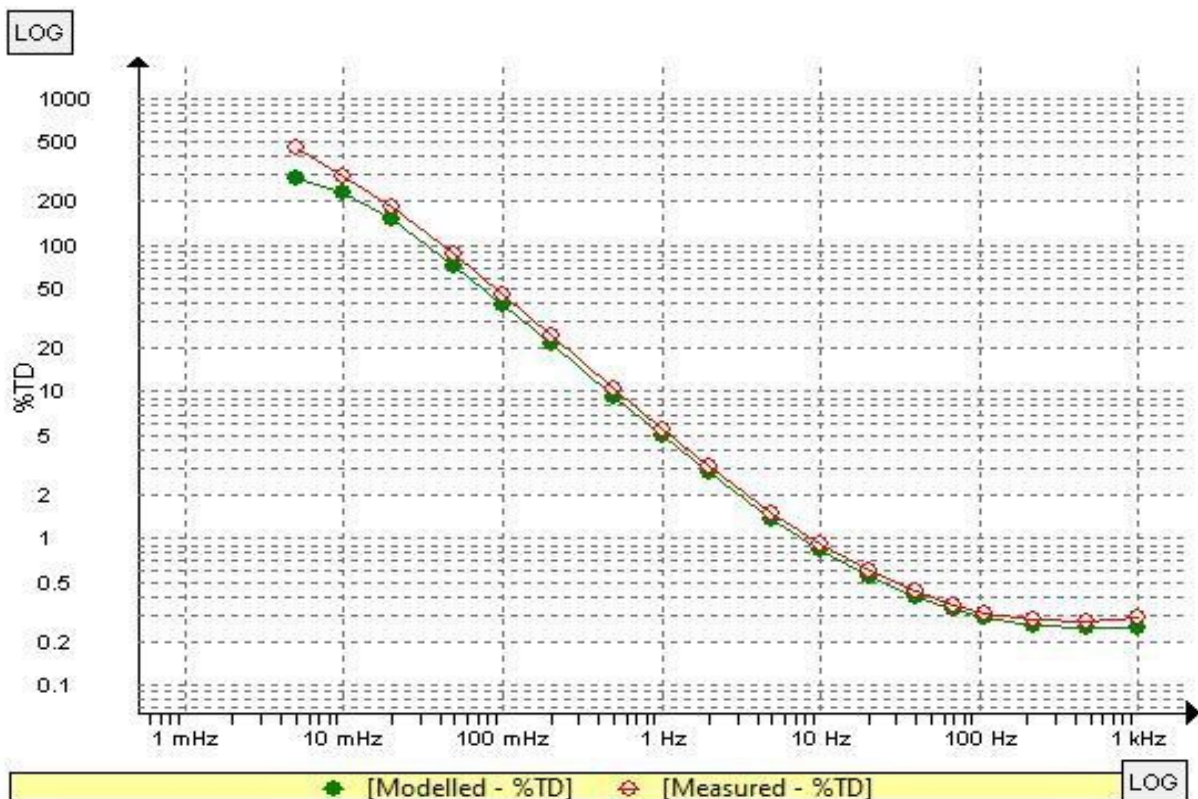


Insulation assessment(CHL)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CHL	140	50	5695	0.399	0.284

Analysis results

%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.284	2.2	0.047
< 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

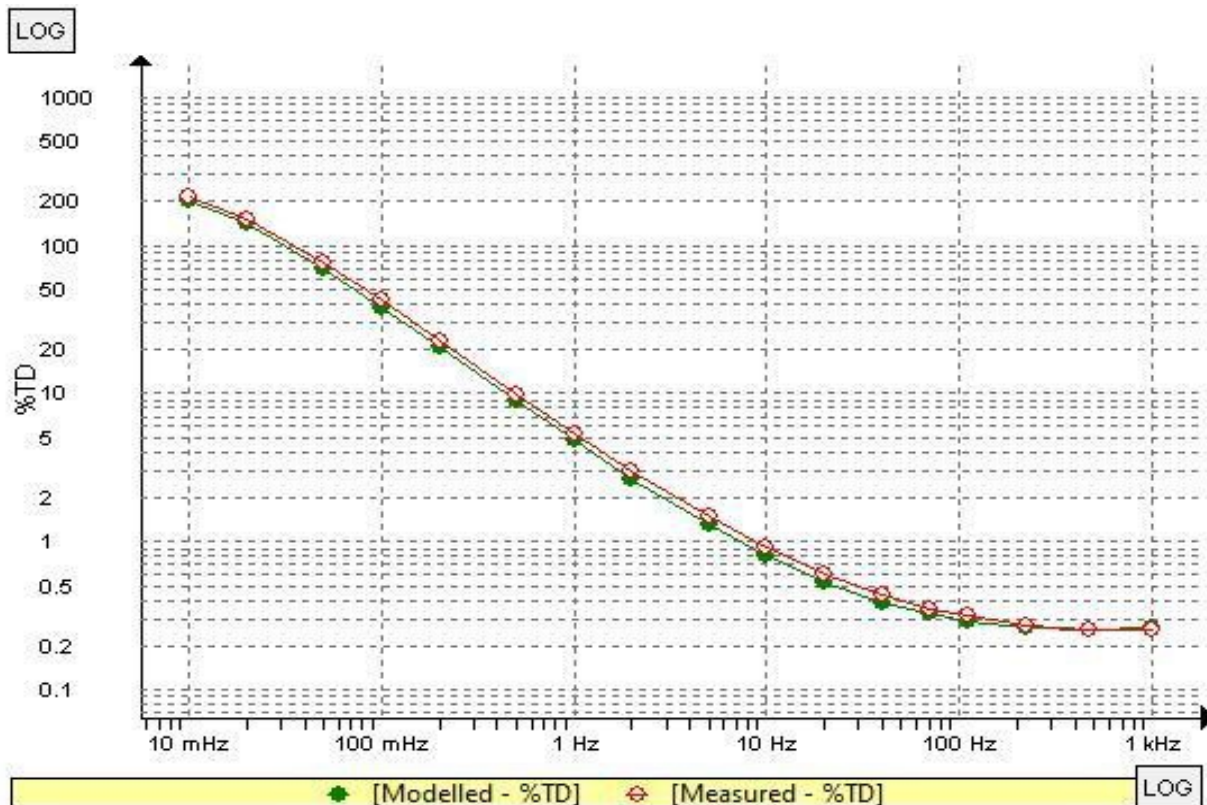


Insulation assessment(CLG)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CLG	140	50	6923	0.404	0.308

Analysis results

%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.308	1.9	0.050
< 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



PPU PENGKALAN HULU T2 BEFORE 2024-07-17 12.16

CHG - (17/7/2024 12:28:08 PM)

TEST MODE	HUM (50Hz)	OFFSET	CAPACITANCE(930Hz, I40 (RMS))
UST-R	4.0 fA	-1.0 nA	5.7 nF
UST-B	---	---	---
UST-RB	4.0 fA*	-1.0 nA*	5.7 nF*
GST-G	300 fA*	933 Aa*	8.0 nF
GSTG-R	304 fA*	-1.0 nA*	2.3 nF*
GSTG-B	300 fA*	933 Aa*	8.0 nF*
GSTG-RB	304 fA	-1.0 nA	2.3 nF

*ESTIMATED FROM MEASUREMENTS OF OTHER TEST MODES

HUM CURRENT IS PEAK VALUE OF THE FUNDAMENTAL

1000	2.33852E-09	5.93319E-12	0.253716	0.253715
470	2.34073E-09	5.78597E-12	0.247186	0.247185
220	2.34316E-09	6.25018E-12	0.266742	0.266741
110	2.34545E-09	7.52995E-12	0.321045	0.321043
70	2.34714E-09	8.91393E-12	0.379779	0.379776
40	2.34953E-09	1.15081E-11	0.489805	0.489799
20	2.35314E-09	1.67747E-11	0.712868	0.712849
10	2.3579E-09	2.60864E-11	1.10634	1.10627
5	2.36448E-09	4.25413E-11	1.79918	1.79889

PPU PENGKALAN HULU T2 BEFORE IDAX.doc

2	2.37802E-09	8.5468E-11	3.59409	3.59177
1	2.39128E-09	1.48679E-10	6.21754	6.20556
0.5	2.4152E-09	2.6757E-10	11.0786	11.0112
0.2	2.45546E-09	6.02261E-10	24.5274	23.8213
0.1	2.50386E-09	1.14229E-09	45.6209	41.5057
0.05	2.59912E-09	2.1878E-09	84.1747	64.3975
0.02	2.88201E-09	5.20956E-09	180.761	87.5025
0.01	3.30095E-09	9.93146E-09	300.867	94.8956

=====

CHL - (17/7/2024 12:18:09 PM)

TEST MODE	HUM (50Hz)	OFFSET	CAPACITANCE (930Hz, 140 (RMS))
UST-R	8.0 nA	48 pA	5.7 nF
UST-B	---	---	---
UST-RB	8.0 nA*	48 pA*	5.7 nF*
GST-G	4.0 nA*	-607 pA*	8.0 nF
GSTG-R	4.0 nA*	-558 pA*	2.3 nF*
GSTG-B	-4.0 nA*	-607 pA*	8.0 nF*
GSTG-RB	4.0 nA	-558 pA	2.3 nF

*ESTIMATED FROM MEASUREMENTS OF OTHER TEST MODES

HUM CURRENT IS PEAK VALUE OF THE FUNDAMENTAL

1000	5.67031E-09	1.6527E-11	0.291466	0.291465
470	5.67486E-09	1.54479E-11	0.272216	0.272215

220	5.68102E-09	1.58709E-11	0.279367	0.279365
110	5.68693E-09	1.78022E-11	0.313037	0.313035
70	5.69125E-09	2.00832E-11	0.352879	0.352876
40	5.69682E-09	2.46501E-11	0.432699	0.432695
20	5.70449E-09	3.44249E-11	0.60347	0.603459
10	5.71359E-09	5.23348E-11	0.915971	0.915932
5	5.72496E-09	8.53321E-11	1.49053	1.49036
2	5.74496E-09	1.77095E-10	3.08262	3.08115
1	5.766E-09	3.22156E-10	5.58716	5.57846
0.5	5.79623E-09	6.01894E-10	10.3842	10.3287
0.2	5.86303E-09	1.41333E-09	24.1059	23.4346
0.1	5.96286E-09	2.73091E-09	45.7986	41.6394
0.05	6.16087E-09	5.28449E-09	85.7751	65.1058
0.02	6.93728E-09	1.24713E-08	179.772	87.3896
0.01	8.1052E-09	2.39067E-08	294.955	94.7051
0.005	9.77876E-09	4.54779E-08	465.068	97.7655

=====

CLG - (17/7/2024 12:33:43 PM)

TEST MODE	HUM (50Hz)	OFFSET	CAPACITANCE (930Hz, 140 (RMS))
UST-R	2.4 nA	8.9 nA	5.7 nF
UST-B	---	---	---
UST-RB	2.4 nA*	8.9 nA*	5.7 nF*
GST-G	2.4 nA*	-9.9 nA*	13 nF
GSTG-R	3.7 fA*	-1.0 nA*	6.9 nF*

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GSTG-B -2.4 NA* -9.9 NA* 13 NF*

GSTG-RB 3.7 FA -1.0 NA 6.9 NF

*ESTIMATED FROM MEASUREMENTS OF OTHER TEST MODES

HUM CURRENT IS PEAK VALUE OF THE FUNDAMENTAL

1000	6.89196E-09	1.72623E-11	0.25047	0.250469
470	6.89813E-09	1.76362E-11	0.255667	0.255666
220	6.90617E-09	1.89394E-11	0.274239	0.274238
110	6.91362E-09	2.16919E-11	0.313756	0.313754
70	6.91903E-09	2.4622E-11	0.35586	0.355857
40	6.92597E-09	3.03807E-11	0.438649	0.438645
20	6.93565E-09	4.21808E-11	0.608174	0.608162
10	6.94721E-09	6.37768E-11	0.91802	0.917982
5	6.96173E-09	1.03161E-10	1.48184	1.48167
2	6.98867E-09	2.11015E-10	3.01938	3.01801
1	7.0179E-09	3.79204E-10	5.40337	5.3955
0.5	7.06054E-09	7.003E-10	9.9185	9.87007
0.2	7.1601E-09	1.62489E-09	22.6936	22.1309
0.1	7.32607E-09	3.10966E-09	42.4465	39.0723
0.05	7.7548E-09	5.93434E-09	76.5248	60.7722
0.02	9.15373E-09	1.3664E-08	149.273	83.0803
0.01	1.16777E-08	2.46286E-08	210.903	90.3574



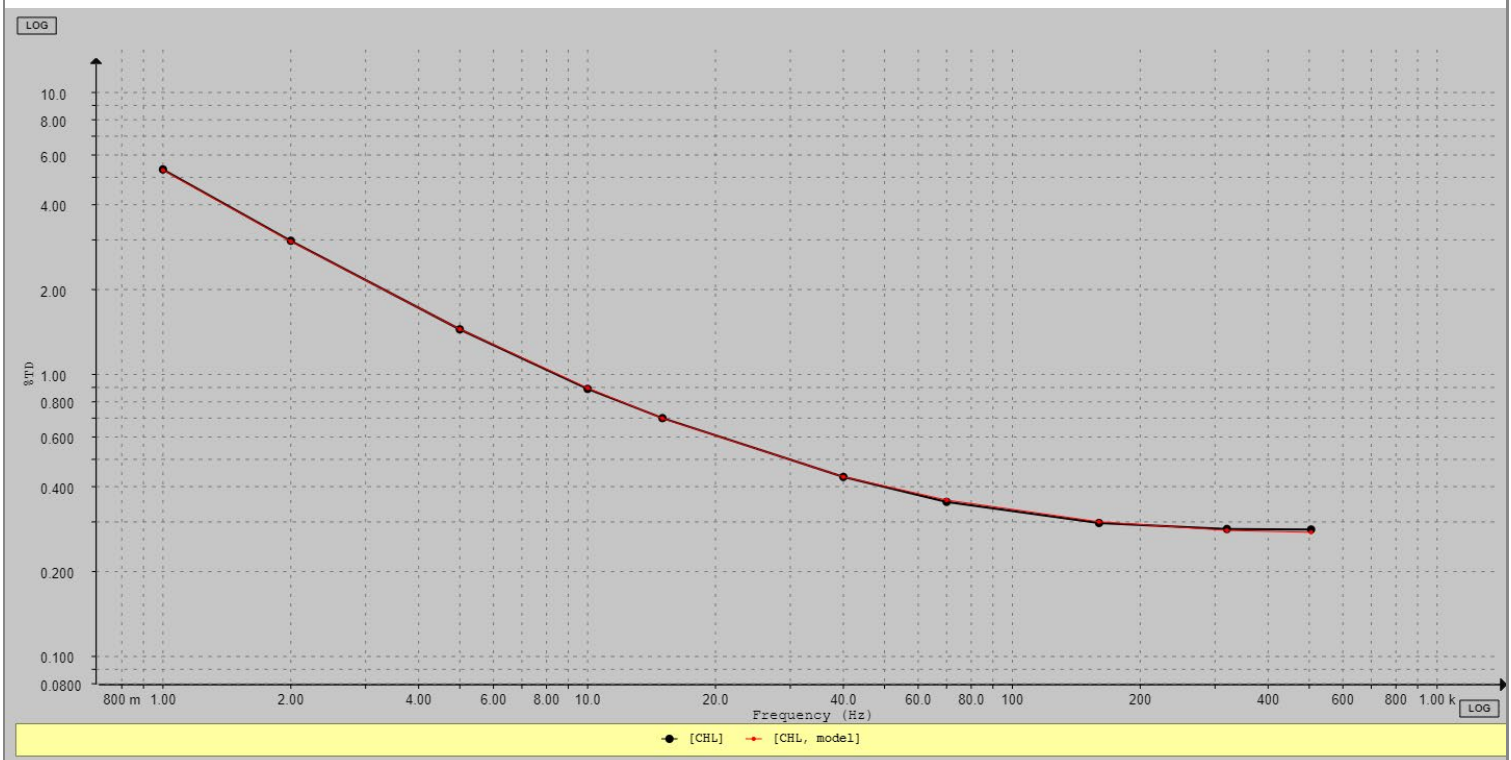
TRANSFORMER TANDELTA TEST REPORT

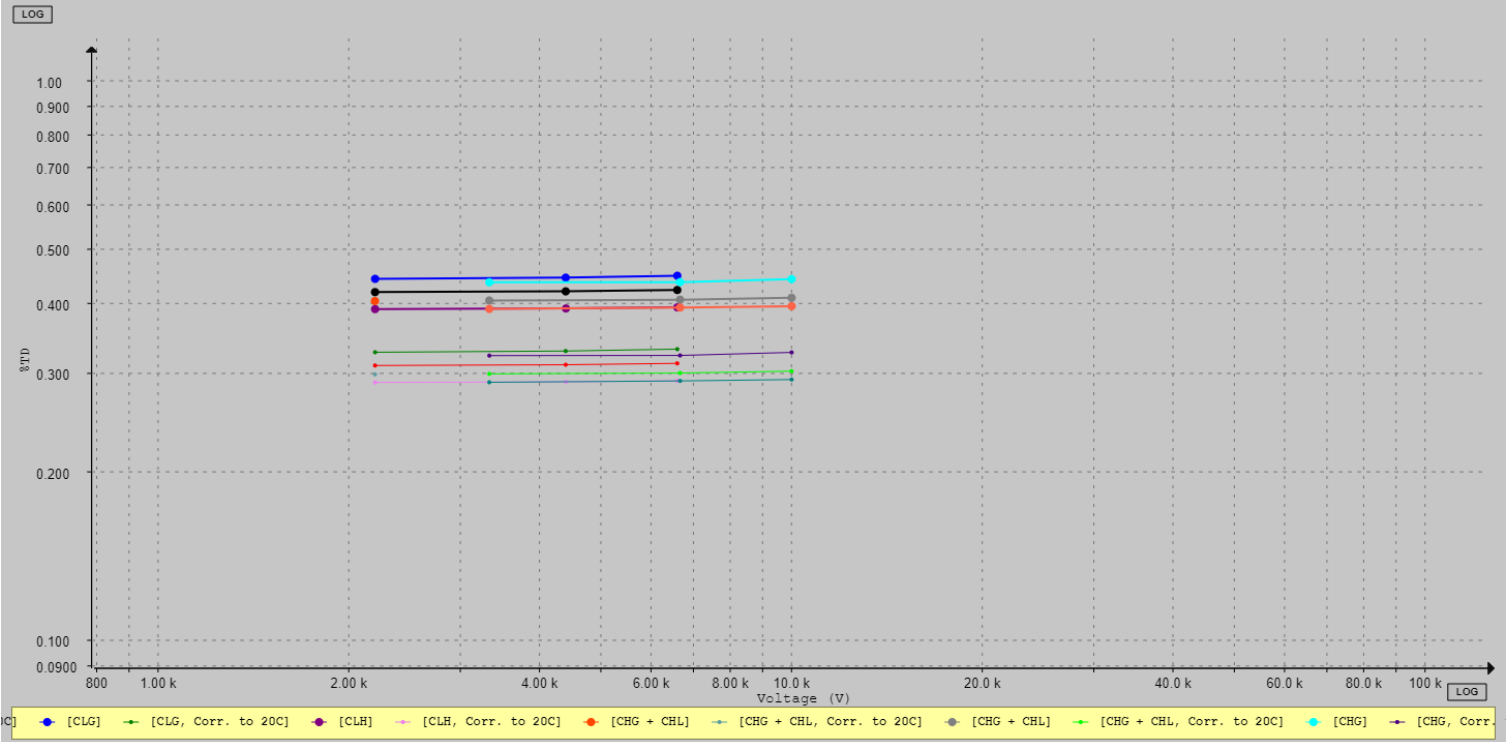
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Engineering (M) Sdn. Bhd.*



Tan Delta - Power Transformer

Designation	Test Mode	f (Hz)	U	I eq	C	%TD at 48 °C	ITC2 Corr. Factor	Corr. %TD to 20°C	P eq at 48 °C	% VDF	ITC2
CHG + CHL	GST-GND	50.00	10.00 kV	25.27 mA	8.045 nF	0.410	0.739	0.303	1.035 W	0.01 %	
CHG	GSTg-RB	50.00	10.01 kV	7.388 mA	2.352 nF	0.442	0.739	0.327	326.7 mW	0.01 %	●
CHL	UST-R	50.00	10.00 kV	17.89 mA	5.694 nF	0.396	0.739	0.292	707.5 mW	0.01 %	
CLG + CLH	GST-GND	50.00	6.600 kV	37.32 mA	11.88 nF	0.427	0.739	0.316	1.593 W	0.01 %	
CLG	GSTg-RB	50.00	6.604 kV	19.44 mA	6.187 nF	0.448	0.739	0.331	871.2 mW	0.01 %	
CLH	UST-R	50.00	6.603 kV	17.89 mA	5.694 nF	0.394	0.739	0.291	704.5 mW	0.01 %	





Comment:



TRANSFORMER EXCITATION 10KV TEST REPORT

*SPAJ Electrical
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Tan Delta - Power Transformer Excitation

Connection	Tap	Tap Voltage (V)	f (Hz)	U	I eq	L	P eq at 48 °C
A-B	1	36 310	50.00	10.00 kV	51.03 mA	990.5 H	396.4 W
B-C	1	36 310	50.00	9.998 kV	15.30 mA	4.219 kH	133.1 W
C-A	1	36 310	50.00	10.00 kV	48.79 mA	1.101 kH	393.0 W
A-B	2	35 759	50.00	10.01 kV	52.32 mA	965.7 H	406.3 W
B-C	2	35 759	50.00	10.01 kV	15.67 mA	4.162 kH	136.8 W
C-A	2	35 759	50.00	10.00 kV	49.97 mA	1.078 kH	403.2 W
A-B	3	35 207	50.00	10.01 kV	53.67 mA	944.5 H	417.6 W
B-C	3	35 207	50.00	10.00 kV	16.04 mA	4.121 kH	140.6 W
C-A	3	35 207	50.00	10.00 kV	51.27 mA	1.054 kH	414.4 W
A-B	4	34 656	50.00	10.02 kV	55.07 mA	921.9 H	429.0 W
B-C	4	34 656	50.00	9.999 kV	16.48 mA	4.034 kH	144.7 W
C-A	4	34 656	50.00	9.993 kV	52.61 mA	1.033 kH	426.4 W
A-B	5	34 105	50.00	9.985 kV	56.63 mA	897.9 H	441.6 W
B-C	5	34 105	50.00	10.00 kV	16.91 mA	3.975 kH	149.0 W
C-A	5	34 105	50.00	9.998 kV	54.00 mA	1.010 kH	438.5 W
A-B	6	33 553	50.00	10.02 kV	58.14 mA	878.8 H	454.7 W
B-C	6	33 553	50.00	9.995 kV	17.36 mA	3.920 kH	153.4 W
C-A	6	33 553	50.00	9.998 kV	55.48 mA	988.0 H	451.7 W
A-B	7	33 002	50.00	10.01 kV	59.74 mA	856.6 H	467.8 W
B-C	7	33 002	50.00	10.00 kV	17.85 mA	3.842 kH	158.1 W
C-A	7	33 002	50.00	10.00 kV	57.05 mA	964.7 H	465.4 W
A-B	8	32 451	50.00	9.989 kV	61.52 mA	834.3 H	482.7 W
B-C	8	32 451	50.00	10.00 kV	19.22 mA	3.129 kH	163.1 W
C-A	8	32 451	50.00	10.01 kV	58.58 mA	944.6 H	479.2 W
A-B	9	31 899	50.00	9.996 kV	64.19 mA	784.6 H	497.4 W
B-C	9	31 899	50.00	10.00 kV	19.76 mA	3.068 kH	168.1 W
C-A	9	31 899	50.00	10.01 kV	61.22 mA	880.2 H	494.0 W
A-B	10	31 348	50.00	10.01 kV	66.09 mA	763.8 H	513.0 W
B-C	10	31 348	50.00	10.01 kV	20.35 mA	2.999 kH	173.6 W
C-A	10	31 348	50.00	9.996 kV	63.08 mA	857.4 H	510.0 W
A-B	11	30 797	50.00	10.03 kV	68.08 mA	745.1 H	530.1 W
B-C	11	30 797	50.00	10.01 kV	20.97 mA	2.927 kH	179.3 W
C-A	11	30 797	50.00	10.02 kV	64.90 mA	838.4 H	526.4 W
A-B	12	30 245	50.00	10.02 kV	70.28 mA	721.9 H	547.3 W
B-C	12	30 245	50.00	10.00 kV	21.62 mA	2.857 kH	185.2 W

Connection	Tap	Tap Voltage (V)	f (Hz)	U	I eq	L	P eq at 48 °C
C-A	12	30 245	50.00	10.00 kV	66.94 mA	815.2 H	543.8 W
A-B	13	29 694	50.00	9.989 kV	72.60 mA	700.9 H	566.4 W
B-C	13	29 694	50.00	9.998 kV	22.31 mA	2.787 kH	191.6 W
C-A	13	29 694	50.00	10.00 kV	69.02 mA	796.5 H	562.7 W
A-B	14	29 143	50.00	9.996 kV	74.97 mA	679.7 H	585.4 W
B-C	14	29 143	50.00	9.997 kV	23.08 mA	2.703 kH	198.5 W
C-A	14	29 143	50.00	9.984 kV	71.28 mA	773.5 H	582.0 W
A-B	15	28 591	50.00	10.02 kV	77.47 mA	660.4 H	606.6 W
B-C	15	28 591	50.00	10.00 kV	23.86 mA	2.632 kH	205.7 W
C-A	15	28 591	50.00	9.995 kV	73.50 mA	755.0 H	602.0 W
A-B	16	28 040	50.00	10.03 kV	80.19 mA	638.7 H	628.3 W
B-C	16	28 040	50.00	10.00 kV	24.89 mA	2.514 kH	214.2 W
C-A	16	28 040	50.00	9.999 kV	75.95 mA	735.8 H	624.3 W

Comment:



TRANSFORMER TURNS RATIO TEST REPORT

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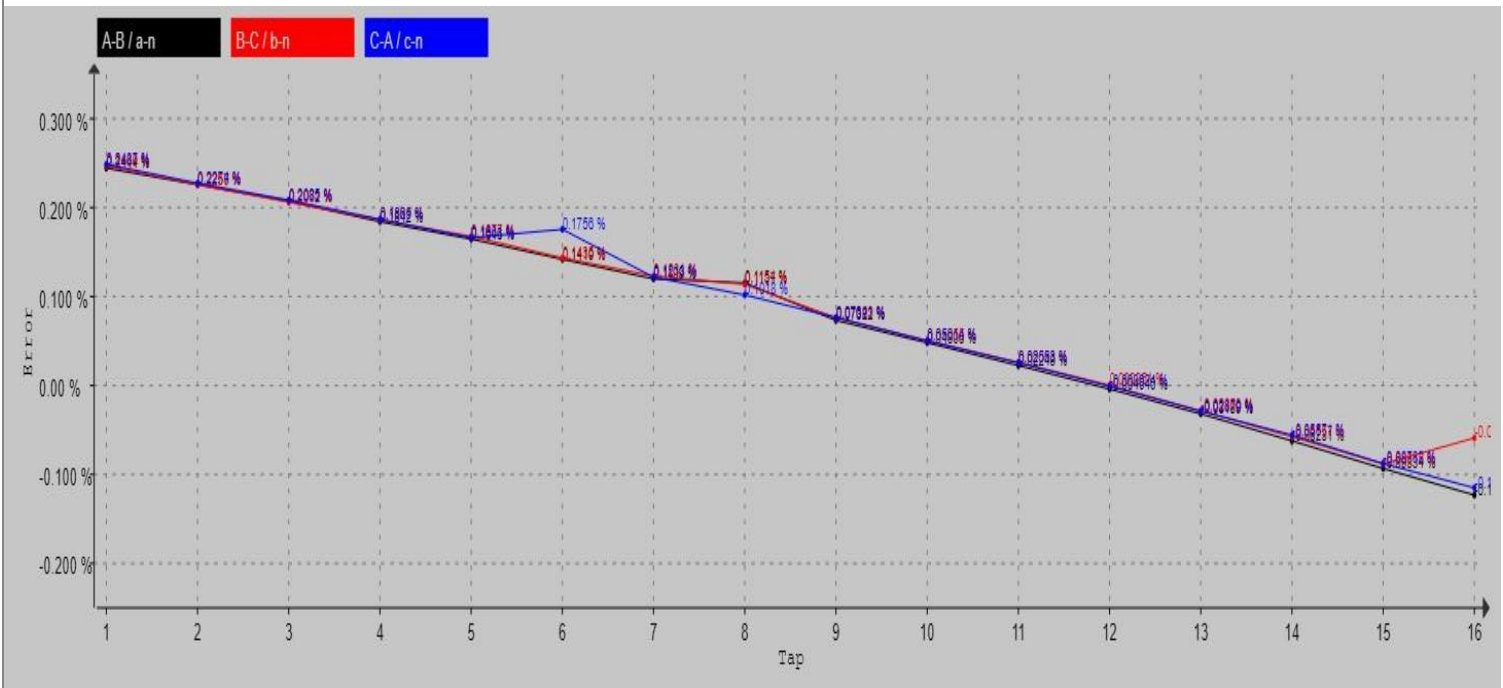


Turns ratio measurements

Connection	Tap (P)	Tap Voltage (V)	U	Test frequency	TTR	Measured TTR	Error	I Exc	Phase
A-B / a-n	1	36 310	125.0 V	50.00 Hz	5.717	5.731	0.24 %	2.640 mA	0.0 °
B-C / b-n	1	36 310	125.0 V	50.00 Hz	5.717	5.731	0.25 %	1.996 mA	0.0 °
C-A / c-n	1	36 310	125.0 V	50.00 Hz	5.717	5.732	0.25 %	2.745 mA	0.0 °
A-B / a-n	2	35 759	125.0 V	50.00 Hz	5.631	5.643	0.23 %	2.715 mA	0.0 °
B-C / b-n	2	35 759	125.0 V	50.00 Hz	5.631	5.643	0.23 %	2.045 mA	0.0 °
C-A / c-n	2	35 759	125.0 V	50.00 Hz	5.631	5.643	0.23 %	2.809 mA	0.0 °
A-B / a-n	3	35 207	125.0 V	50.00 Hz	5.544	5.555	0.21 %	2.790 mA	0.0 °
B-C / b-n	3	35 207	125.0 V	50.00 Hz	5.544	5.555	0.21 %	2.101 mA	0.0 °
C-A / c-n	3	35 207	125.0 V	50.00 Hz	5.544	5.555	0.21 %	2.879 mA	0.0 °
A-B / a-n	4	34 656	125.0 V	50.00 Hz	5.457	5.467	0.18 %	2.868 mA	0.0 °
B-C / b-n	4	34 656	125.0 V	50.00 Hz	5.457	5.467	0.19 %	2.162 mA	0.0 °
C-A / c-n	4	34 656	125.0 V	50.00 Hz	5.457	5.467	0.19 %	2.959 mA	0.0 °
A-B / a-n	5	34 105	125.0 V	50.00 Hz	5.370	5.379	0.16 %	2.950 mA	0.0 °
B-C / b-n	5	34 105	125.0 V	50.00 Hz	5.370	5.379	0.17 %	2.223 mA	0.0 °
C-A / c-n	5	34 105	125.0 V	50.00 Hz	5.370	5.379	0.17 %	3.047 mA	0.0 °
A-B / a-n	6	33 553	125.0 V	50.00 Hz	5.283	5.291	0.14 %	3.028 mA	0.0 °
B-C / b-n	6	33 553	125.0 V	50.00 Hz	5.283	5.291	0.14 %	2.285 mA	0.0 °
C-A / c-n	6	33 553	125.0 V	50.00 Hz	5.283	5.293	0.18 %	3.138 mA	0.03 °
A-B / a-n	7	33 002	125.0 V	50.00 Hz	5.196	5.203	0.12 %	3.112 mA	0.0 °
B-C / b-n	7	33 002	125.0 V	50.00 Hz	5.196	5.203	0.12 %	2.358 mA	0.0 °
C-A / c-n	7	33 002	125.0 V	50.00 Hz	5.196	5.203	0.12 %	3.221 mA	0.0 °
A-B / a-n	8	32 451	125.0 V	50.00 Hz	5.110	5.116	0.12 %	3.230 mA	0.02 °
B-C / b-n	8	32 451	125.0 V	50.00 Hz	5.110	5.115	0.11 %	2.425 mA	0.01 °
C-A / c-n	8	32 451	125.0 V	50.00 Hz	5.110	5.115	0.10 %	3.326 mA	0.0 °
A-B / a-n	9	31 899	125.0 V	50.00 Hz	5.023	5.027	0.07 %	3.331 mA	0.0 °
B-C / b-n	9	31 899	125.0 V	50.00 Hz	5.023	5.027	0.08 %	2.524 mA	0.0 °
C-A / c-n	9	31 899	125.0 V	50.00 Hz	5.023	5.027	0.08 %	3.416 mA	0.0 °
A-B / a-n	10	31 348	125.0 V	50.00 Hz	4.936	4.938	0.05 %	3.433 mA	0.0 °
B-C / b-n	10	31 348	125.0 V	50.00 Hz	4.936	4.939	0.05 %	2.605 mA	0.0 °
C-A / c-n	10	31 348	125.0 V	50.00 Hz	4.936	4.939	0.05 %	3.517 mA	0.0 °
A-B / a-n	11	30 797	125.0 V	50.00 Hz	4.849	4.850	0.02 %	3.538 mA	0.0 °
B-C / b-n	11	30 797	125.0 V	50.00 Hz	4.849	4.850	0.03 %	2.684 mA	0.0 °
C-A / c-n	11	30 797	125.0 V	50.00 Hz	4.849	4.850	0.03 %	3.629 mA	0.0 °
A-B / a-n	12	30 245	125.0 V	50.00 Hz	4.762	4.762	-0.00 %	3.650 mA	0.0 °
B-C / b-n	12	30 245	125.0 V	50.00 Hz	4.762	4.762	0.00 %	2.761 mA	0.0 °
C-A / c-n	12	30 245	125.0 V	50.00 Hz	4.762	4.762	-0.00 %	3.748 mA	0.0 °
A-B / a-n	13	29 694	125.0 V	50.00 Hz	4.676	4.674	-0.03 %	3.757 mA	0.0 °
B-C / b-n	13	29 694	125.0 V	50.00 Hz	4.676	4.674	-0.03 %	2.845 mA	0.0 °

Connection	Tap (P)	Tap Voltage (V)	U	Test frequency	TTR	Measured TTR	Error	I Exc	Phase
C-A / c-n	13	29 694	125.0 V	50.00 Hz	4.676	4.674	-0.03 %	3.861 mA	0.0 °
A-B / a-n	14	29 143	125.0 V	50.00 Hz	4.589	4.586	-0.06 %	3.874 mA	0.0 °
B-C / b-n	14	29 143	125.0 V	50.00 Hz	4.589	4.586	-0.06 %	2.936 mA	0.0 °
C-A / c-n	14	29 143	125.0 V	50.00 Hz	4.589	4.586	-0.06 %	3.973 mA	0.0 °
A-B / a-n	15	28 591	125.0 V	50.00 Hz	4.502	4.498	-0.09 %	4.012 mA	0.0 °
B-C / b-n	15	28 591	125.0 V	50.00 Hz	4.502	4.498	-0.09 %	3.034 mA	0.0 °
C-A / c-n	15	28 591	125.0 V	50.00 Hz	4.502	4.498	-0.09 %	4.097 mA	0.0 °
A-B / a-n	16	28 040	125.0 V	50.00 Hz	4.415	4.410	-0.12 %	4.148 mA	0.0 °
B-C / b-n	16	28 040	125.0 V	50.00 Hz	4.415	4.413	-0.06 %	3.137 mA	0.04 °
C-A / c-n	16	28 040	125.0 V	50.00 Hz	4.415	4.410	-0.12 %	4.233 mA	0.0 °

Comment:





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

RECOGNIZED AND CERTIFIED USER OF **Megger**



TRANSFORMER DC WINDING RESISTANCE TEST REPORT

***SPAJ Electrical
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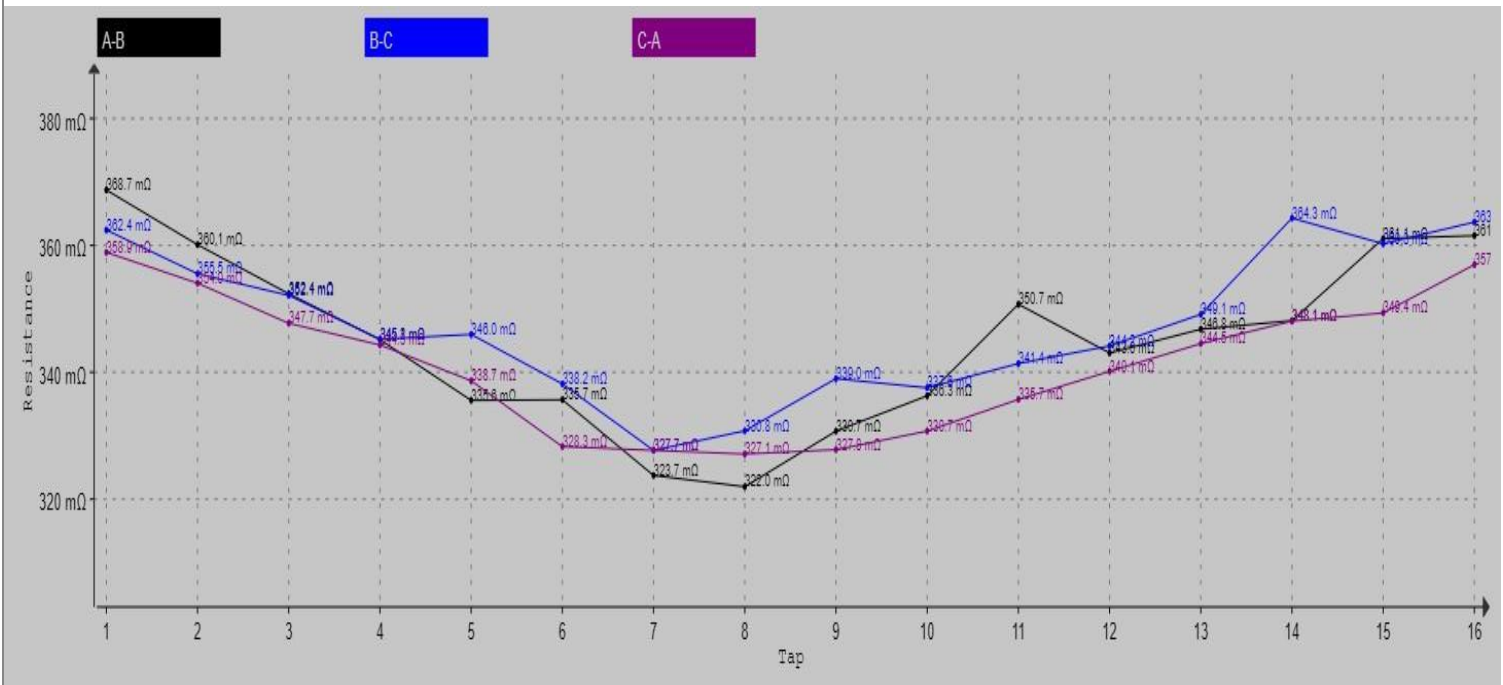


HV Winding resistance measurements

Connection	▼ Tap (P)	Current	48°C Resistance corrected to 75°C	Stability	Variation	Continuity
A-B	1	10.00 A	403.9 mΩ	98.40 %	---	✓
B-C	1	10.04 A	397.0 mΩ	99.95 %	---	✓
C-A	1	10.03 A	393.1 mΩ	99.10 %	2.70 %	✓
A-B	2	10.02 A	394.5 mΩ	99.89 %	---	✓
B-C	2	10.04 A	389.4 mΩ	99.50 %	---	✓
C-A	2	10.01 A	387.8 mΩ	99.71 %	1.70 %	✓
A-B	3	10.03 A	386.0 mΩ	99.76 %	---	✓
B-C	3	10.03 A	385.7 mΩ	99.77 %	---	✓
C-A	3	10.01 A	380.9 mΩ	99.41 %	1.33 %	✓
A-B	4	10.02 A	378.1 mΩ	99.55 %	---	✓
B-C	4	10.05 A	378.1 mΩ	99.26 %	---	✓
C-A	4	10.01 A	377.2 mΩ	99.45 %	0.26 %	✓
A-B	5	10.01 A	367.6 mΩ	99.60 %	---	✓
B-C	5	10.04 A	379.0 mΩ	99.58 %	---	✓
C-A	5	10.02 A	371.0 mΩ	99.60 %	3.06 %	✓
A-B	6	10.01 A	367.7 mΩ	99.73 %	---	✓
B-C	6	10.03 A	370.4 mΩ	99.54 %	---	✓
C-A	6	10.02 A	359.6 mΩ	99.56 %	2.96 %	✓
A-B	7	10.01 A	354.6 mΩ	99.52 %	---	✓
B-C	7	10.02 A	359.0 mΩ	99.96 %	---	✓
C-A	7	10.02 A	358.9 mΩ	99.68 %	1.21 %	✓
A-B	8	10.01 A	352.7 mΩ	99.73 %	---	✓
B-C	8	10.03 A	362.3 mΩ	99.41 %	---	✓
C-A	8	10.01 A	358.3 mΩ	99.17 %	2.69 %	✓
A-B	9	10.01 A	362.3 mΩ	99.49 %	---	✓
B-C	9	10.00 A	371.3 mΩ	98.56 %	---	✓
C-A	9	10.02 A	359.1 mΩ	99.63 %	3.37 %	✓
A-B	10	10.02 A	368.4 mΩ	99.81 %	---	✓
B-C	10	10.04 A	369.8 mΩ	99.78 %	---	✓
C-A	10	10.01 A	362.3 mΩ	99.62 %	2.04 %	✓
A-B	11	10.01 A	384.2 mΩ	99.88 %	---	✓
B-C	11	10.03 A	373.9 mΩ	99.87 %	---	✓
C-A	11	10.00 A	367.7 mΩ	99.85 %	4.38 %	✓
A-B	12	10.00 A	375.8 mΩ	99.29 %	---	✓
B-C	12	10.03 A	377.0 mΩ	99.49 %	---	✓
C-A	12	10.01 A	372.6 mΩ	99.68 %	1.17 %	✓
A-B	13	10.02 A	379.9 mΩ	99.96 %	---	✓

Connection	▼ Tap (P)	Current	48°C Resistance corrected to 75°C	Stability	Variation	Continuity
B-C	13	10.03 A	382.4 mΩ	99.91 %	---	✓
C-A	13	10.01 A	377.4 mΩ	99.64 %	1.33 %	✓
A-B	14	10.01 A	381.4 mΩ	99.91 %	---	✓
B-C	14	10.04 A	399.0 mΩ	98.77 %	---	✓
C-A	14	10.01 A	381.3 mΩ	99.86 %	4.59 %	✓
A-B	15	10.02 A	395.5 mΩ	99.88 %	---	✓
B-C	15	10.02 A	394.6 mΩ	99.85 %	---	✓
C-A	15	10.02 A	382.7 mΩ	99.89 %	3.28 %	✓
A-B	16	10.05 A	396.0 mΩ	99.99 %	---	✓
B-C	16	10.00 A	398.4 mΩ	99.17 %	---	✓
C-A	16	10.01 A	391.0 mΩ	99.66 %	1.86 %	✓

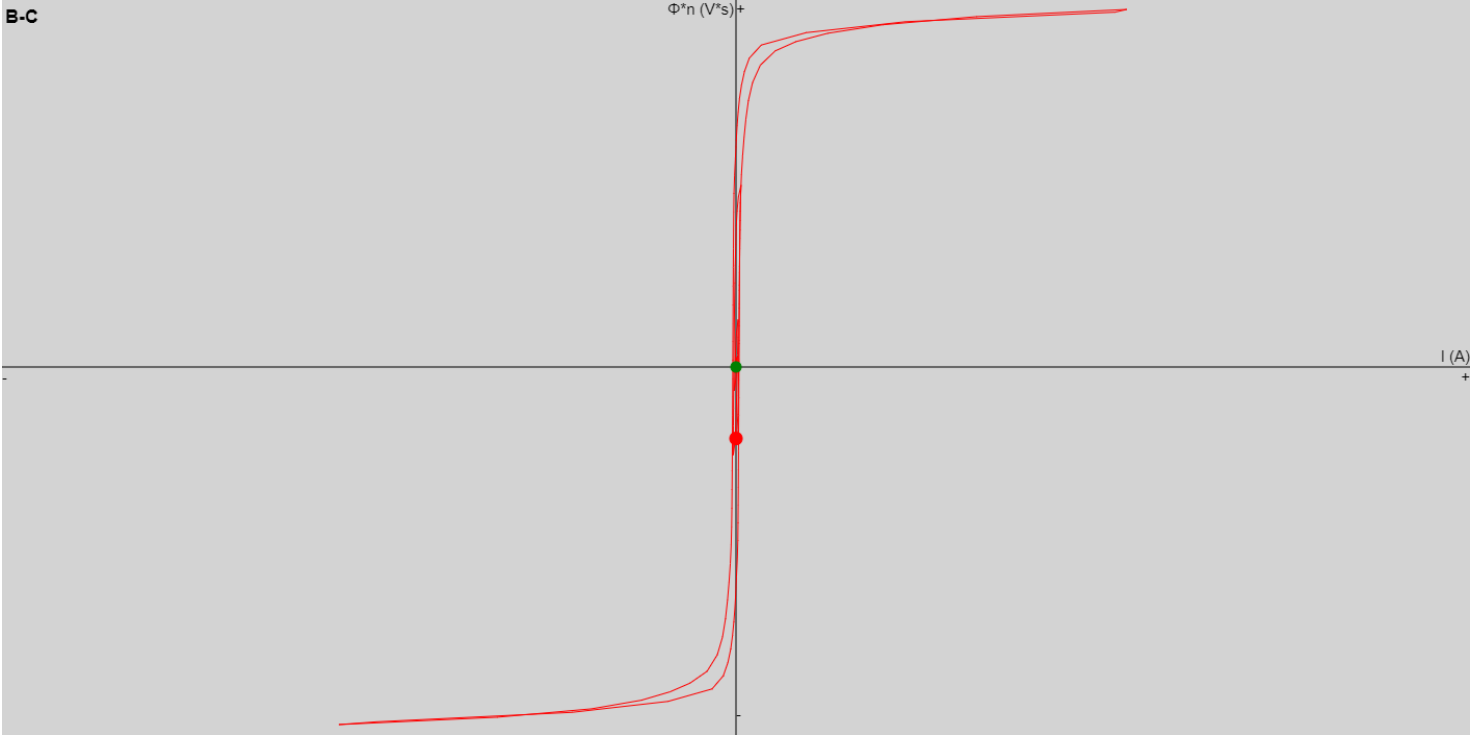
Comment:





Demag measurements

Designation	Current	Time	Remanence before demag	Remanence after demag
B-C	0.000 A	29.57 s	19.86 %	<1 %



Comment:



LV Winding resistance measurement

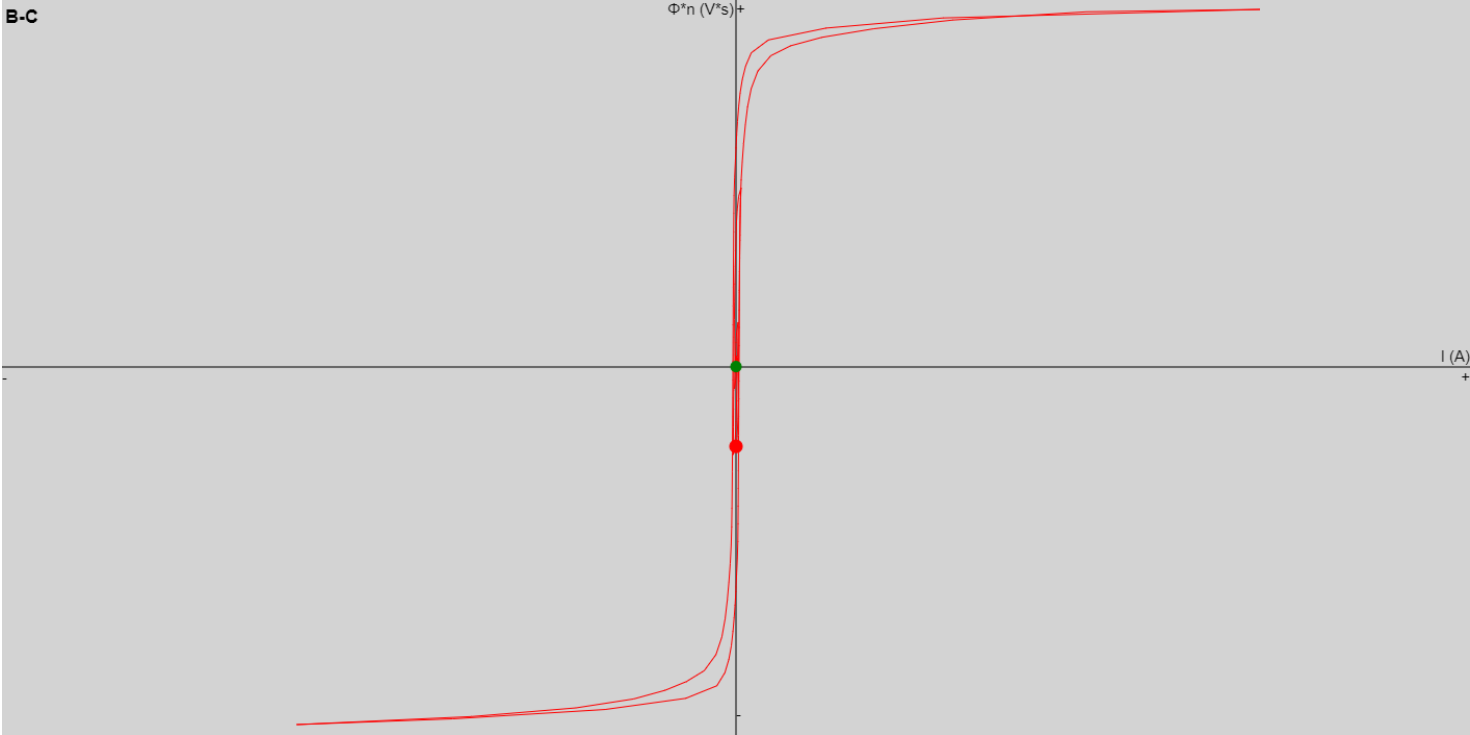
Connection	▼ Tap (S)	Current	48°C Resistance corrected to 75°C	Stability	Variation
a-n	1	10.00 A	23.31 mΩ	99.25 %	---
b-n	1	10.00 A	23.21 mΩ	99.84 %	---
c-n	1	9.985 A	23.50 mΩ	99.14 %	1.24 %

Comment:



Demag measurements

Designation	Current	Time	Remanence before demag	Remanence after demag
B-C	0.000 A	29.15 s	22.30 %	<1 %



Comment:



TRANSFORMER OLTC DYNAMIC RESISTANCE TEST REPORT

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



On Load Tap Changer Measurements

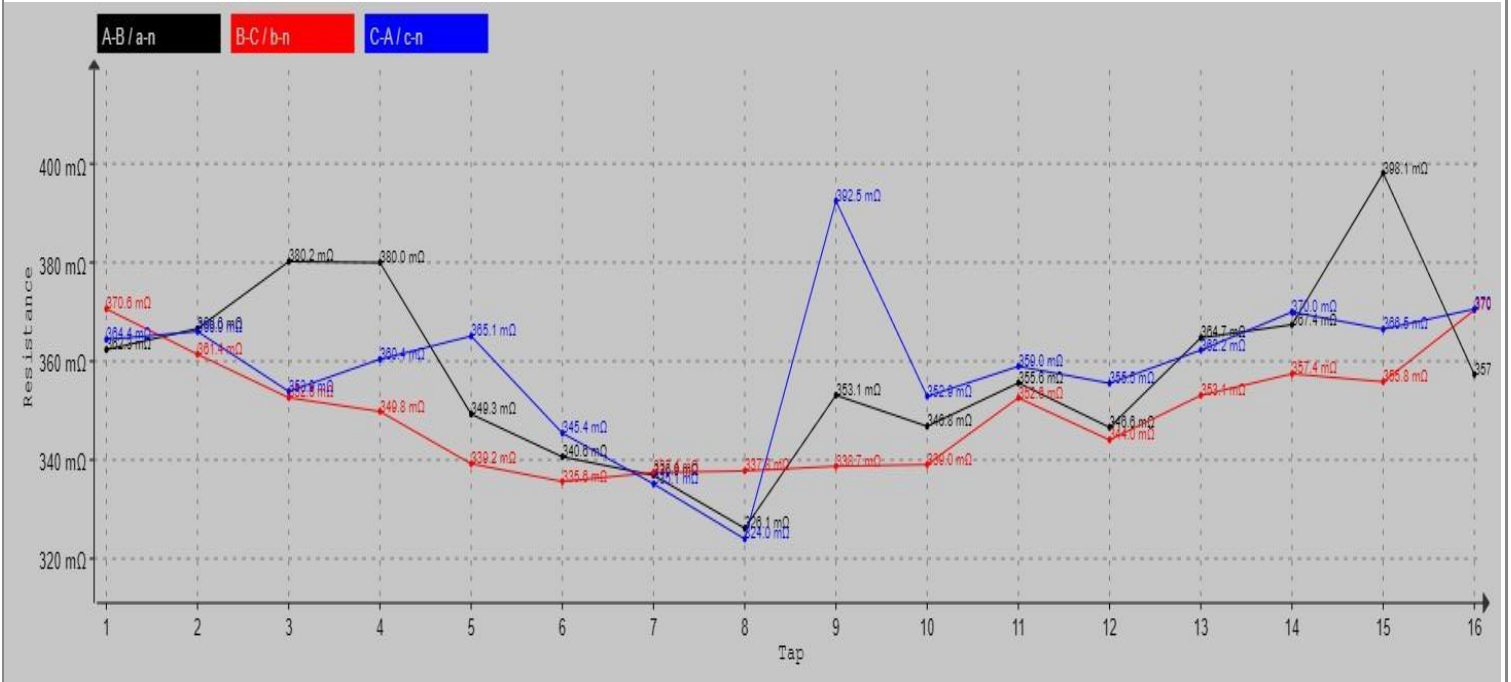
Software configuration

OLTC Type		Taps on		Secondary Side		
Non-vacuum R		Primary		Open Circuit		
Connection	Transition	t start	t	Ripple	Slope	Continuity
A-B / a-n	16 → 15	4.807 s	66.9 ms	11.65 %	8.667 A/s	✓
A-B / a-n	15 → 14	4.524 s	66.3 ms	11.72 %	8.958 A/s	✓
A-B / a-n	14 → 13	4.522 s	64.6 ms	11.11 %	8.575 A/s	✓
A-B / a-n	13 → 12	4.522 s	68.1 ms	11.17 %	8.217 A/s	✓
A-B / a-n	12 → 11	4.532 s	66.4 ms	10.71 %	7.952 A/s	✓
A-B / a-n	11 → 10	4.548 s	66.7 ms	10.56 %	7.849 A/s	✓
A-B / a-n	10 → 9	4.521 s	66.2 ms	10.37 %	7.797 A/s	✓
A-B / a-n	9 → 8	4.525 s	65.1 ms	10.05 %	7.669 A/s	✓
A-B / a-n	8 → 7	4.512 s	63.4 ms	8.160 %	6.373 A/s	✓
A-B / a-n	7 → 6	4.518 s	66.3 ms	9.976 %	7.471 A/s	✓
A-B / a-n	6 → 5	4.518 s	65 ms	9.596 %	7.334 A/s	✓
A-B / a-n	5 → 4	4.509 s	66.8 ms	9.559 %	7.086 A/s	✓
A-B / a-n	4 → 3	4.525 s	67.8 ms	9.703 %	7.214 A/s	✓
A-B / a-n	3 → 2	4.535 s	65.5 ms	9.384 %	7.141 A/s	✓
A-B / a-n	2 → 1	4.504 s	64.1 ms	8.916 %	6.892 A/s	✓
A-B / a-n	--	---	---	---	---	✓
B-C / b-n	1 → 2	4.598 s	64.1 ms	8.625 %	6.752 A/s	✓
B-C / b-n	2 → 3	4.325 s	62.7 ms	8.357 %	6.633 A/s	✓
B-C / b-n	3 → 4	4.353 s	64.5 ms	8.808 %	6.832 A/s	✓
B-C / b-n	4 → 5	4.331 s	61.9 ms	8.623 %	6.873 A/s	✓
B-C / b-n	5 → 6	4.336 s	63.6 ms	8.930 %	6.964 A/s	✓
B-C / b-n	6 → 7	4.327 s	63.3 ms	9.096 %	7.157 A/s	✓
B-C / b-n	7 → 8	4.303 s	63.3 ms	9.085 %	7.122 A/s	✓
B-C / b-n	8 → 9	4.306 s	63.6 ms	10.85 %	8.470 A/s	✓
B-C / b-n	9 → 10	4.303 s	63.4 ms	9.410 %	7.395 A/s	✓
B-C / b-n	10 → 11	4.302 s	62.6 ms	9.577 %	7.616 A/s	✓
B-C / b-n	11 → 12	4.31 s	63.6 ms	9.892 %	7.806 A/s	✓
B-C / b-n	12 → 13	4.336 s	61.4 ms	9.485 %	7.617 A/s	✓
B-C / b-n	13 → 14	4.325 s	63.4 ms	9.956 %	7.795 A/s	✓
B-C / b-n	14 → 15	4.321 s	62.8 ms	10.16 %	8.049 A/s	✓
B-C / b-n	15 → 16	4.311 s	63.6 ms	10.49 %	8.187 A/s	✓
B-C / b-n	--	---	---	---	---	✓
C-A / c-n	16 → 15	4.819 s	65.6 ms	10.96 %	8.324 A/s	✓
C-A / c-n	15 → 14	4.51 s	64.9 ms	10.84 %	8.327 A/s	✓
C-A / c-n	14 → 13	4.513 s	66.4 ms	10.78 %	8.088 A/s	✓
C-A / c-n	13 → 12	4.501 s	66.3 ms	10.55 %	7.896 A/s	✓
C-A / c-n	12 → 11	4.525 s	66.4 ms	10.41 %	7.825 A/s	✓
C-A / c-n	11 → 10	4.523 s	66.7 ms	10.27 %	7.713 A/s	✓
C-A / c-n	10 → 9	4.562 s	65.6 ms	9.990 %	7.619 A/s	✓
C-A / c-n	9 → 8	4.529 s	65.6 ms	10.05 %	7.989 A/s	✓
C-A / c-n	8 → 7	4.505 s	61.8 ms	7.728 %	6.182 A/s	✓

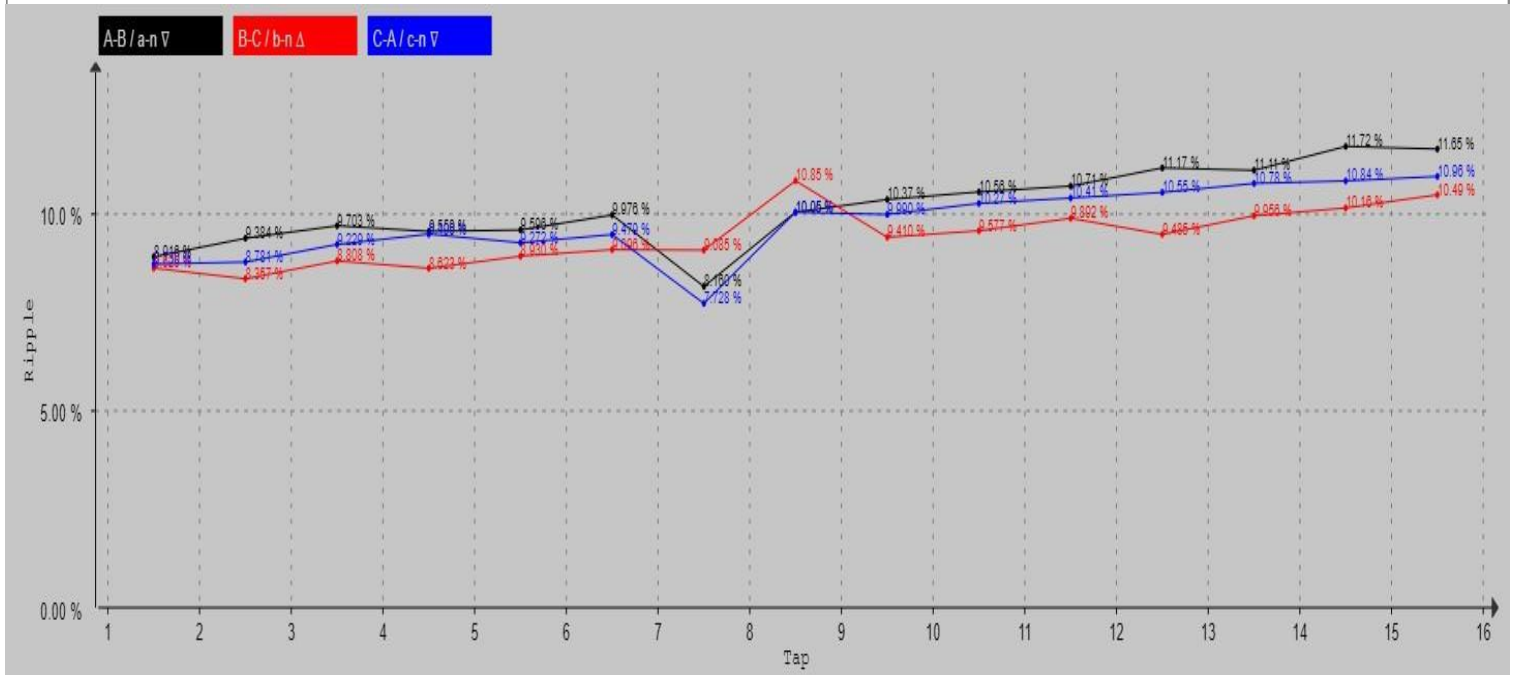
Connection	▲ Transition	t start	t	Ripple	Slope	Continuity
C-A / c-n	7 → 6	4.506 s	65.7 ms	9.479 %	7.188 A/s	✓
C-A / c-n	6 → 5	4.516 s	66.2 ms	9.272 %	6.963 A/s	✓
C-A / c-n	5 → 4	4.516 s	67.2 ms	9.490 %	7.178 A/s	✓
C-A / c-n	4 → 3	4.522 s	67.7 ms	9.229 %	6.817 A/s	✓
C-A / c-n	3 → 2	4.534 s	65.3 ms	8.781 %	6.645 A/s	✓
C-A / c-n	2 → 1	4.506 s	64.9 ms	8.730 %	6.686 A/s	✓
C-A / c-n	--	---	---	---	---	✓
48°C Resistance corrected to 75°C						
Connection	▲ Tap (P)	Tap Voltage (V)	Current		Stability	Variation
A-B / a-n	16	28 040	5.002 A	391.4 mΩ	99.91 %	---
A-B / a-n	15	28 591	5.000 A	436.1 mΩ	99.71 %	---
A-B / a-n	14	29 143	5.000 A	402.4 mΩ	99.92 %	---
A-B / a-n	13	29 694	5.000 A	399.5 mΩ	98.93 %	---
A-B / a-n	12	30 245	5.000 A	379.7 mΩ	99.81 %	---
A-B / a-n	11	30 797	5.000 A	389.5 mΩ	99.75 %	---
A-B / a-n	10	31 348	5.000 A	379.9 mΩ	99.96 %	---
A-B / a-n	9	31 899	5.000 A	386.8 mΩ	99.37 %	---
A-B / a-n	8	32 451	5.000 A	357.3 mΩ	99.89 %	---
A-B / a-n	7	33 002	5.000 A	369.0 mΩ	99.82 %	---
A-B / a-n	6	33 553	5.001 A	373.1 mΩ	99.15 %	---
A-B / a-n	5	34 105	5.001 A	382.6 mΩ	99.88 %	---
A-B / a-n	4	34 656	5.000 A	416.2 mΩ	99.66 %	---
A-B / a-n	3	35 207	5.000 A	416.5 mΩ	99.95 %	---
A-B / a-n	2	35 759	5.000 A	401.6 mΩ	99.70 %	---
A-B / a-n	1	36 310	5.000 A	396.9 mΩ	99.91 %	---
B-C / b-n	1	36 310	5.000 A	405.9 mΩ	99.05 %	---
B-C / b-n	2	35 759	5.001 A	395.9 mΩ	99.65 %	---
B-C / b-n	3	35 207	5.002 A	386.2 mΩ	99.84 %	---
B-C / b-n	4	34 656	5.001 A	383.2 mΩ	99.70 %	---
B-C / b-n	5	34 105	5.000 A	371.6 mΩ	99.52 %	---
B-C / b-n	6	33 553	5.000 A	367.6 mΩ	99.72 %	---
B-C / b-n	7	33 002	5.001 A	369.6 mΩ	99.89 %	---
B-C / b-n	8	32 451	5.000 A	370.0 mΩ	99.77 %	---
B-C / b-n	9	31 899	4.999 A	371.0 mΩ	99.33 %	---
B-C / b-n	10	31 348	4.999 A	371.4 mΩ	99.86 %	---
B-C / b-n	11	30 797	5.001 A	386.2 mΩ	99.74 %	---
B-C / b-n	12	30 245	5.000 A	376.9 mΩ	99.44 %	---
B-C / b-n	13	29 694	5.003 A	386.7 mΩ	99.95 %	---
B-C / b-n	14	29 143	5.001 A	391.5 mΩ	99.87 %	---
B-C / b-n	15	28 591	5.002 A	389.8 mΩ	99.91 %	---

Connection	▲ Tap (P)	Tap Voltage (V)	Current	48°C Resistance corrected to 75°C	Stability	Variation
B-C / b-n	16	28 040	5.000 A	405.7 mΩ	99.80 %	---
C-A / c-n	16	28 040	5.000 A	405.9 mΩ	99.78 %	3.62 %
C-A / c-n	15	28 591	5.000 A	401.5 mΩ	99.89 %	7.32 %
C-A / c-n	14	29 143	5.000 A	405.3 mΩ	99.69 %	3.44 %
C-A / c-n	13	29 694	5.000 A	396.8 mΩ	99.83 %	3.24 %
C-A / c-n	12	30 245	5.000 A	389.4 mΩ	99.95 %	3.29 %
C-A / c-n	11	30 797	5.000 A	393.2 mΩ	99.76 %	1.80 %
C-A / c-n	10	31 348	5.000 A	386.6 mΩ	99.68 %	4.00 %
C-A / c-n	9	31 899	5.000 A	429.9 mΩ	99.99 %	7.87 %
C-A / c-n	8	32 451	5.000 A	354.9 mΩ	99.89 %	4.19 %
C-A / c-n	7	33 002	5.000 A	367.1 mΩ	99.97 %	0.68 %
C-A / c-n	6	33 553	5.000 A	378.4 mΩ	99.88 %	2.88 %
C-A / c-n	5	34 105	5.000 A	399.9 mΩ	99.62 %	7.37 %
C-A / c-n	4	34 656	5.000 A	394.8 mΩ	99.95 %	7.30 %
C-A / c-n	3	35 207	5.000 A	387.7 mΩ	99.91 %	7.62 %
C-A / c-n	2	35 759	5.000 A	400.9 mΩ	99.98 %	1.43 %
C-A / c-n	1	36 310	5.000 A	399.2 mΩ	99.94 %	2.26 %

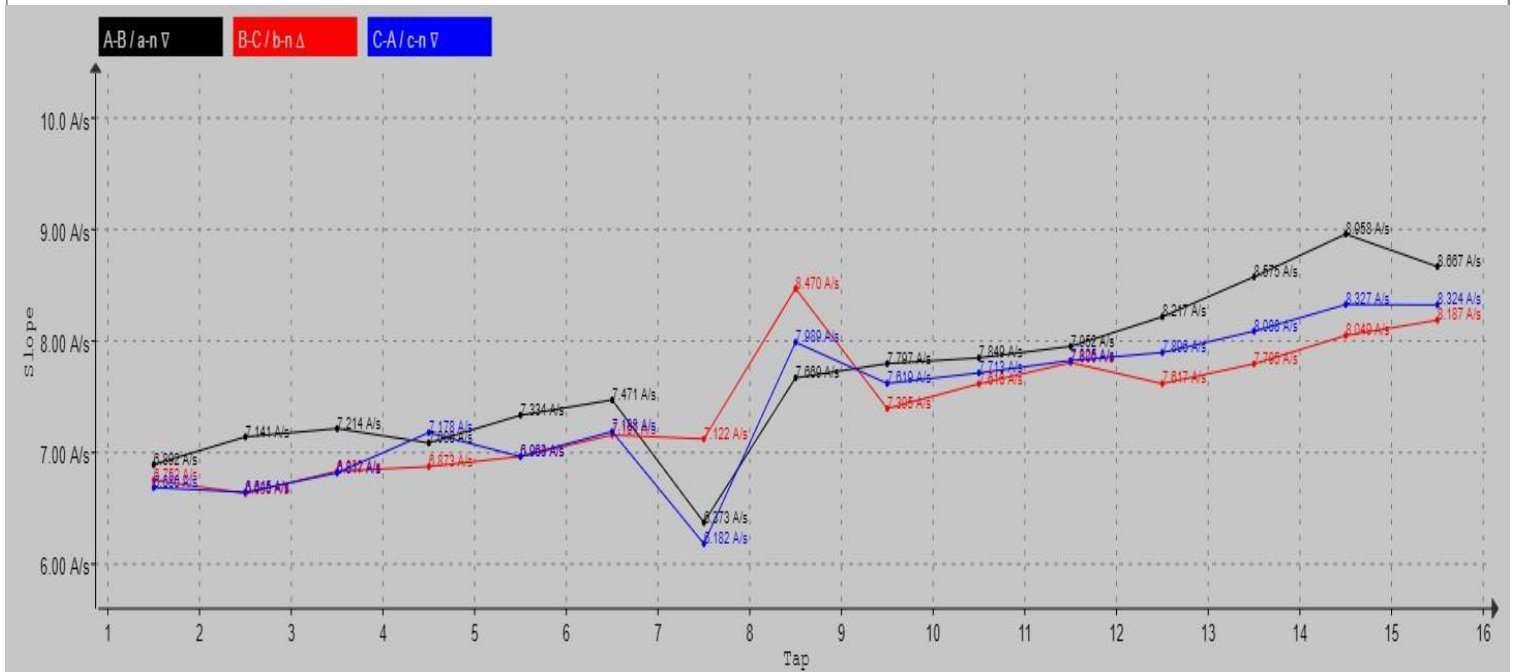
WRM



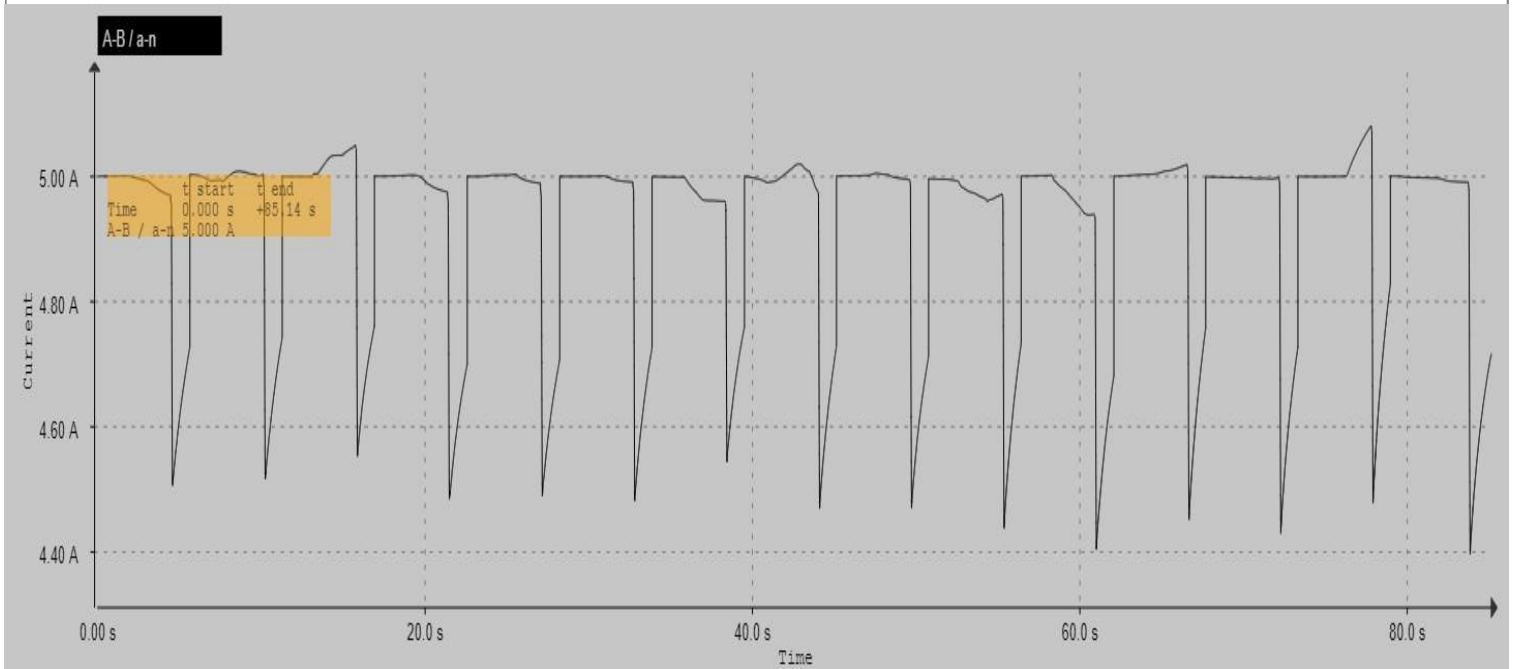
Ripple



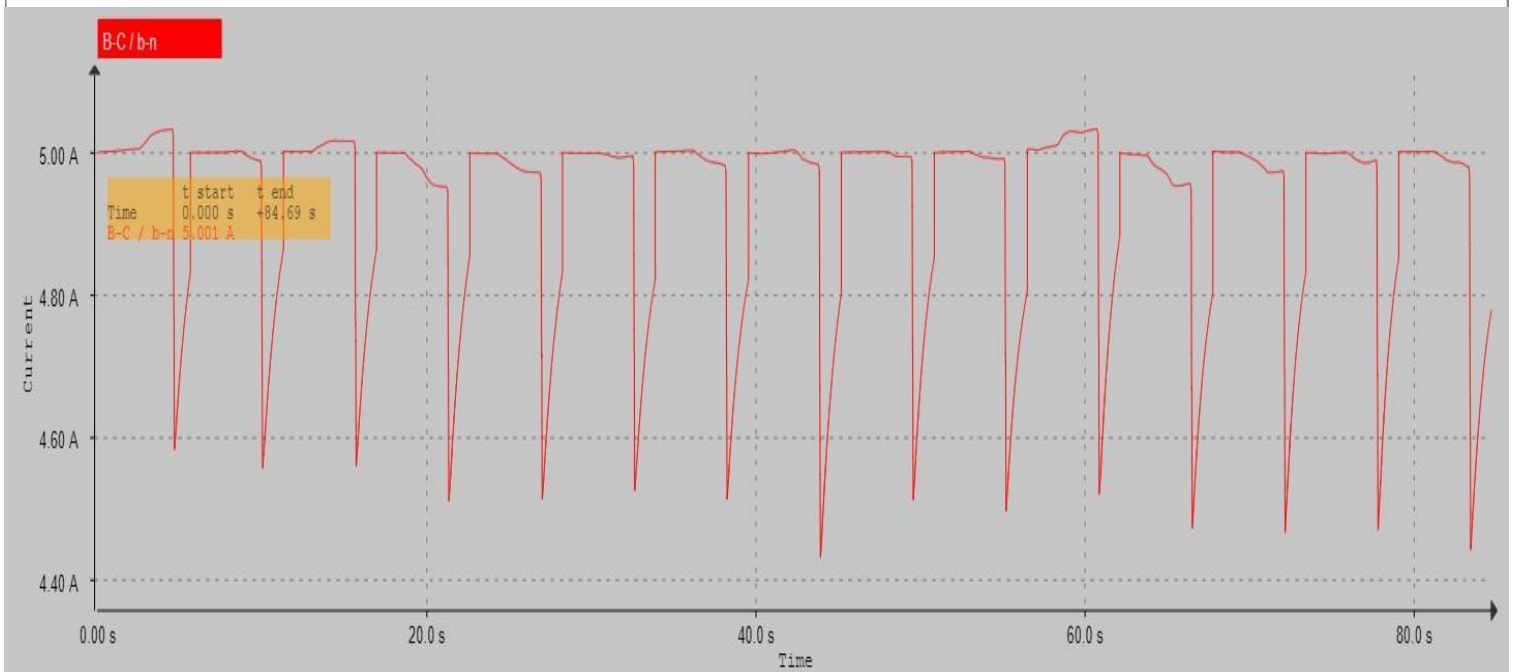
Slope



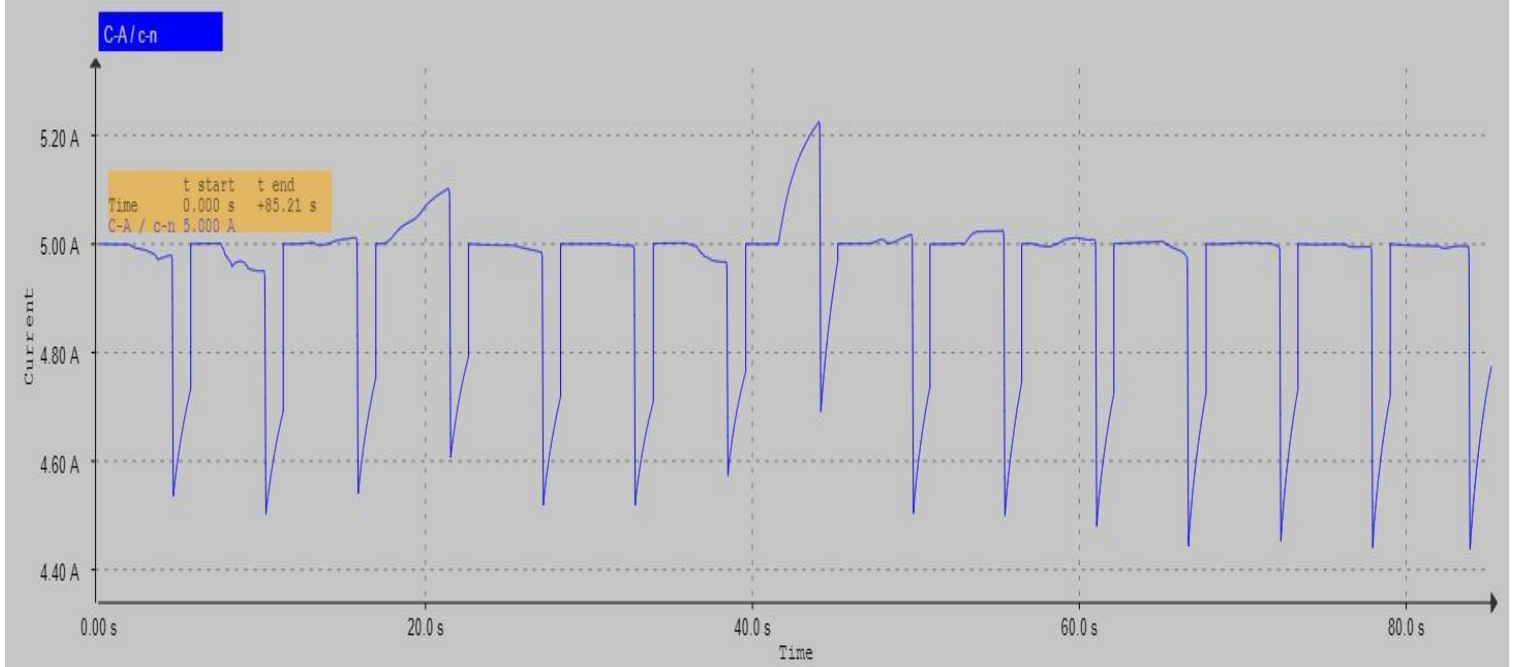
Dynamic Current



Dynamic Current



Dynamic Current



Comment:



TRANSFORMER INSULATION RESISTANCE TEST REPORT

*SPAJ Electrical
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**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	BAY ID: TX2
Station : PPU PENGKALAN HULU	Manufacture year: 2008	
Circuit : 33/11KV MTM TRANSFORMER :2	Serial No.: P/320/07/15010	

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:

MAINTANANCE :

TRANSFORMER INSULATION

1 Min Reading:

10 Min Reading :

**Polarization
Index > 1.2**

HV To E : 760 MΩ

HV To E : 940 MΩ

1.236842

LV To E : 560 MΩ

LV To E : 680 MΩ

1.214286

HVTo LV: 575 MΩ

HVTo LV: 700 MΩ

1.217391

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. ARIF Dept: TNB	Name: Dept:	
Date: 17/07/2024	Date: 17/07/2024	Date: 17/07/2024	



TRANSFORMER CT RATIO, POLARITY & SATURATION

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

TEST REPORT

TRAX - Test report

Test Asset

Substation	PPU PENGKALAN HULU
Position	PERAK
Job	BEFORE SERVICE
Transformer	TX2

Test Conditions

Reason	MAJOR	°C ▼ %
Weather	SUNNY	
Ambient Temperature	36	
Humidity	65.00	
Date	17/07/2024	
Tester	VICKNESH	

Current Transformer Information

Number of CTs	2
---------------	---

CT1

Manufacturer	MTM	Year	2008
Serial	P/320/07/15010	Number of cores	1
Type	15-201	Standard	IEC76
Frequency	50	Primary voltage (kV)	0
Notes			

Core 1

Label	CT1-HV	Taps	2	Type	Meter
In service tap	1S1	FS Alf	0	Accuracy class	3
Primary nominal current	309	Secondary nominal current	1.5	CT VA rating	15VA
Notes					
Compensated ALF/FS	Calculated at:		FS-C		

Insulation resistance result

Primary to secondary		Primary to ground		Secondary to ground	
Reading	Testvoltage (kV)	Reading	Testvoltage (kV)	Reading	Testvoltage (kV)
	MOhm		MOhm		MOhm

CT2

Manufacturer	MTM	Year	2008
Serial	P/320/07/15010	Number of cores	1
Type	15-201	Standard	IEC76
Frequency	50	Primary voltage (kV)	0
Notes			

Core 1

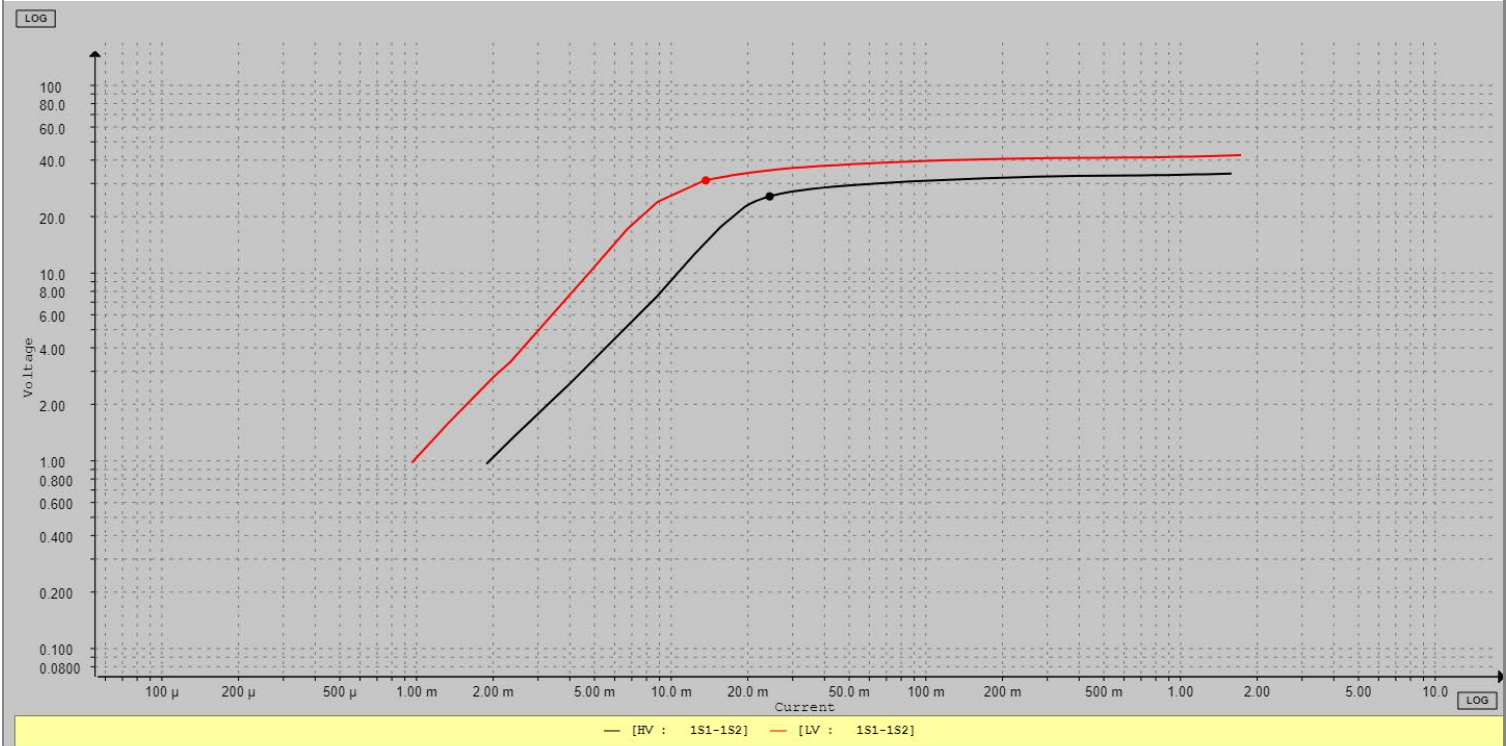
Label	CT2-LV	Taps	2	Type	Meter
-------	--------	------	---	------	-------

In service tap	1S1		FS Alf	0		Accuracy class	3	
Primary nominal current	787		Secondary nominal current	1.5		CT VA rating	15VA	
Notes								
Compensated ALF/FS	Calculated at:				FS-C			
Insulation resistance result								
Primary to secondary			Primary to ground			Secondary to ground		
Reading		Testvoltage (kV)	Reading		Testvoltage (kV)	Reading		Testvoltage (kV)
	MOhm			MOhm			MOhm	
Comment:								
Test results								



CT Saturation measurements

Designation	Test frequency	I _{knee}	U _{knee}
HV : 1S1-1S2	50.00 Hz	24.36 mA	25.63 V
LV : 1S1-1S2	50.00 Hz	13.67 mA	31.18 V



Comment:

CT1		CT2	
Core1		Core1	
HV : 1S1-1S2		LV : 1S1-1S2	
Current	Voltage	Current	Voltage
1.883 mA	963.6 mV	958.0 μA	977.2 mV
2.431 mA	1.358 V	1.337 mA	1.595 V
2.979 mA	1.764 V	1.679 mA	2.184 V
3.409 mA	2.099 V	2.015 mA	2.808 V
3.883 mA	2.478 V	2.346 mA	3.382 V
8.815 mA	7.538 V	4.834 mA	10.25 V
12.32 mA	12.58 V	6.714 mA	17.11 V
15.64 mA	17.62 V	8.855 mA	23.99 V
19.55 mA	22.67 V	13.37 mA	30.96 V
20.04 mA	23.11 V	14.01 mA	31.42 V
20.55 mA	23.51 V	14.75 mA	31.88 V
21.15 mA	23.94 V	15.56 mA	32.32 V
21.77 mA	24.35 V	16.47 mA	32.78 V
22.51 mA	24.77 V	17.49 mA	33.23 V
23.34 mA	25.19 V	18.67 mA	33.69 V
24.30 mA	25.60 V	19.91 mA	34.12 V
25.38 mA	26.02 V	21.40 mA	34.57 V
26.70 mA	26.43 V	23.09 mA	35.00 V
28.28 mA	26.85 V	25.11 mA	35.45 V
30.26 mA	27.26 V	27.43 mA	35.87 V
32.62 mA	27.68 V	30.36 mA	36.31 V
35.55 mA	28.08 V	33.98 mA	36.74 V
39.24 mA	28.49 V	38.38 mA	37.15 V
43.70 mA	28.88 V	44.25 mA	37.58 V
49.30 mA	29.28 V	50.90 mA	37.99 V
56.20 mA	29.67 V	59.11 mA	38.39 V

64.45 mA	30.04 V	68.80 mA	38.79 V
74.86 mA	30.42 V	80.88 mA	39.17 V
87.30 mA	30.77 V	96.36 mA	39.54 V
103.6 mA	31.12 V	116.0 mA	39.87 V
122.8 mA	31.44 V	142.2 mA	40.17 V
145.4 mA	31.74 V	172.9 mA	40.41 V
171.4 mA	32.01 V	207.0 mA	40.61 V
201.0 mA	32.25 V	243.1 mA	40.76 V
233.7 mA	32.46 V	280.1 mA	40.89 V
268.2 mA	32.62 V	319.4 mA	41.01 V
306.0 mA	32.76 V	362.4 mA	41.12 V
343.8 mA	32.87 V	668.8 mA	41.26 V
385.6 mA	32.98 V	749.8 mA	41.36 V
707.4 mA	33.11 V	830.6 mA	41.46 V
786.9 mA	33.21 V	915.5 mA	41.56 V
872.2 mA	33.30 V	1.005 A	41.67 V
959.4 mA	33.38 V	1.098 A	41.78 V
1.052 A	33.46 V	1.193 A	41.88 V
1.149 A	33.55 V	1.293 A	42.00 V
1.248 A	33.63 V	1.393 A	42.12 V
1.352 A	33.71 V	1.502 A	42.24 V
1.463 A	33.79 V	1.610 A	42.37 V
1.586 A	33.89 V	1.729 A	42.51 V

 CT ratio U measurements							
Designation	U	Ratio	Measured ratio	Ratio Error	Phase Error	Polarity	Current
HV : 1S1-1S2/P1-P2	4.996 V	309.0 : 1.500 (206.0)	204.4	0.80 %	0.02 °	Pass	8.153 mA
LV : 1S1-1S2/P1-P2	4.995 V	787.0 : 1.500 (524.7)	520.8	0.75 %	0.05 °	Pass	2.994 mA
Comment:							



TRANSFORMER AVR CALIBRATION 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	BAY ID: TX2
Station : PPU PENGKALAN HULU	Manufacture year: 2008	
Circuit : 33/11KV MTM TRANSFORMER :2	Serial No.: P/320/07/15010	

AUTOMATIC VOLTAGE REGULATING RELAY TEST CERTIFICATE I

Voltage Regulating Relay:

Make : MR	Type : TAPCON 230
Frequency : 50 HZ	Rated AC Voltage : 110V

1. OPERATING TIME TEST:

Setting (sec)	Time Measured(sec)
60	60↑ 61↓

Remarks: 1. ↑ TAP RAISE OPERATION 2. ↓ TAP LOWER OPERATION

2. UNDER VOLTAGE CHECK BLOCK :

Setting (%KV)	Pick - Up Voltage(KV)	Drop-off Voltage(KV)
85%	9.18	9.23

3. OVER VOLTAGE CHECK BY PASS SET TIME :

Setting (%KV)	Pick - Up Voltage(KV)	Drop-off Voltage(KV)
110%	11.87	11.82

4. OPERATING VOLTAGE AT SET LEVEL :

VOLTAGE	BANDWIDTH - 1.5		BANDWIDTH - 2		BANDWIDTH - 3	
SETTING	RAISE	LOWER	RAISE	LOWER	RAISE	LOWER
10.8 KV	-	-	10.58	11.02	-	-

BANDWIDTH	:1.5 %	TIME	: 60 Sec
UNDER VOLTAGE	:85%	VOLTAGE LEVEL	10.8KV
OVER VOLTAGE	:110%		

Comments: 1. AVR Bandwidth operation setting quite high. Recommend to change Bandwidth setting.

Tested by:	Witnessed by TNB:	Verified by ESE :	ESE COMMENT:
Name: VICKNESH Dept: TESTER	Name: Mr. ARIF Dept: TNB		
Date: 17/07/2024	Date: 17/07/2024	Date: 17/07/2024	



TRANSFORMER OTI,WTI CALIBRATION TEST REPORT

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



SPAJ Electrical
Engineering (M) Sdn. Bhd.

TEST CERTIFICATE
POWER TRANSFORMER TEST

Megger

Client : TENAGA NASIONAL BERHAD	Main Contractor : MALAYSIA TRANSFORMER MANUFACTURING SDN BHD	TX2
Station : PPU PENGKALAN HULU	Manufacture year: 2008	
Circuit : 33/11KV MTM TRANSFORMER-2	Serial No.: P/320/07/15010	

WINDING TEMPERATURE & OIL TEMPERATURE CALIBRATION CERTIFICATE

W/T HV Serial No.	:1441469-16
W/T LV Serial No.	:1441469-30
Oil Temp Serial No.	:1481342-04

A. Calibration Of Temperature Indicator

OIL TEMP	TEMPERATURE INDICATORS (°C)		
(°C)	WTI HV	WTI LV	OIL
130	130	130	130
120	120	120	120
110	110	110	110
100	100	100	100
90	90	90	90
80	80	80	80
70	70	70	70
60	60	60	60
50	50	50	50
40	40	40	40
Ambient(°C)	40	40	40

Calibration of Secondary Amps. Injection:

Duration	W/T (HV)	W/T (LV)
Min.	(°C)	(°C)
0	34	34
10	37	39
20	41	42
30	44	45
45	48	49

HV- 1.27 A LV – 1.5A
Element 0.72 A Element -0.80 A

Make: (AKM)-KIHLSSTROMS

Remarks :

B. Temperature Indicators Settings

Temperature Indicator		Setting	PICK UP	DROP OFF
Winding Temp Hv	Fan	70	70	58
Winding Temp Hv	Alarm	95	95	78
Winding Temp Hv	Trip	110	110	104
Winding Temp Lv	Fan	70	70	56
Winding Temp Lv	Alarm	95	95	78
Winding Temp Lv	Trip	110	110	104
Oil Temp	Alarm	85	84	76
Oil Temp	Trip	95	92	85

Remarks : OTI, HV & LV WTI Settings needs to be change.

Tested by:	Witnessed by TNB:	Verified by ESE :	ESE COMMENT:
Name: VICKNESH Dept: TESTER	Name: IHYAK Dept: TNB		
Date: 17/07/2024	Date: 17/07/2024	Date: 17/07/2024	



TRANSFORMER GUARD TEST REPORT
***SPAJ Electrical
Engineering (M) Sdn. Bhd.***

TRANSFORMER TESTING REPORTS

Location: PPU PENGKALAN HULU

Job: T2 AFTER SERVICE

Date: 04/08/2024

TRANSFORMER NO	: 02
SERIAL NO	: P/320/07/15010
VOLTAGE	: 33000/11000
KVA	: 15000
MANUFACTURE	: MTM
YEAR	: 2008
TESTING DATE	: 04/08/2024

TEST PERFORMED

S.NO.	TITLE
1	SWEEP FREQUENCY RESPONSE ANALYSIS(SFRA)
2	FREQUENCY DOMAIN SPECTROSCOPY(FDS)
3	TANDELTA WINDING
4	EXCITATION CURRENT 10KV
5	TURN RATIO MEASUREMENT
6	DC WINDING RESISTANCE
7	OLTC DYNAMIC RESISTANCE
8	INSULATION RESISTANCE / POLARIZATION INDEX
9	TRANSFORMER CT RATIO,POLARITY & SATURATION
10	TRANSFORMER OTI,WTI CALIBRATION
11	TRANSFORMER AVR CALIBRATION
12	TRANSFORMER GUARD

TEST EQUIPMENT USED :

1. MEGGER FRAX 101
2. MEGGER IDAX 300
3. MEGGER TDX 120
4. MEGGER TRAX 220
5. MEGGER MIT515 INSULATION TESTER

TESTING PERFORMED BY:

1. VICKNESH A/L SUBRAMANIAM
2. GOBINATH RAJU
3. SAKTHI



TRANSFORMER SWEEP FREQUENCY RESPONSE ANALYSIS (FRAX) TEST REPORT

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

SFRA Test Results

Report date: 2024-08-04

Test date:

4/8/2024

Test time:

10:13:49

Company:

MTM

Substation

PPU PENGKALAN HULU T2 AFTER

Designation:

PERAK

Manufacturer:

MTM

Serial number

P/320/07/15010

Year of manufacturing:

2008

Type:

15-201

Vector group:

Dyn11 (D-Y, 30° lead)

Voltage rating (kV):

33-11

Power rating (MVA):

15

Impedance (%):

9.9

Cooling:

ONAN/ONAF

OLTC extreme rise position

16

OLTC reg. winding out position:

1

DETC position:

Relative humidity:

65

Air temperature:

34

Object temperature:

40

Weather:

SUNNY

Tested by:

VICKNESH

Notes:

Designation: "PERAK" at "PPU PENGKALAN HULU T2 AFTER"

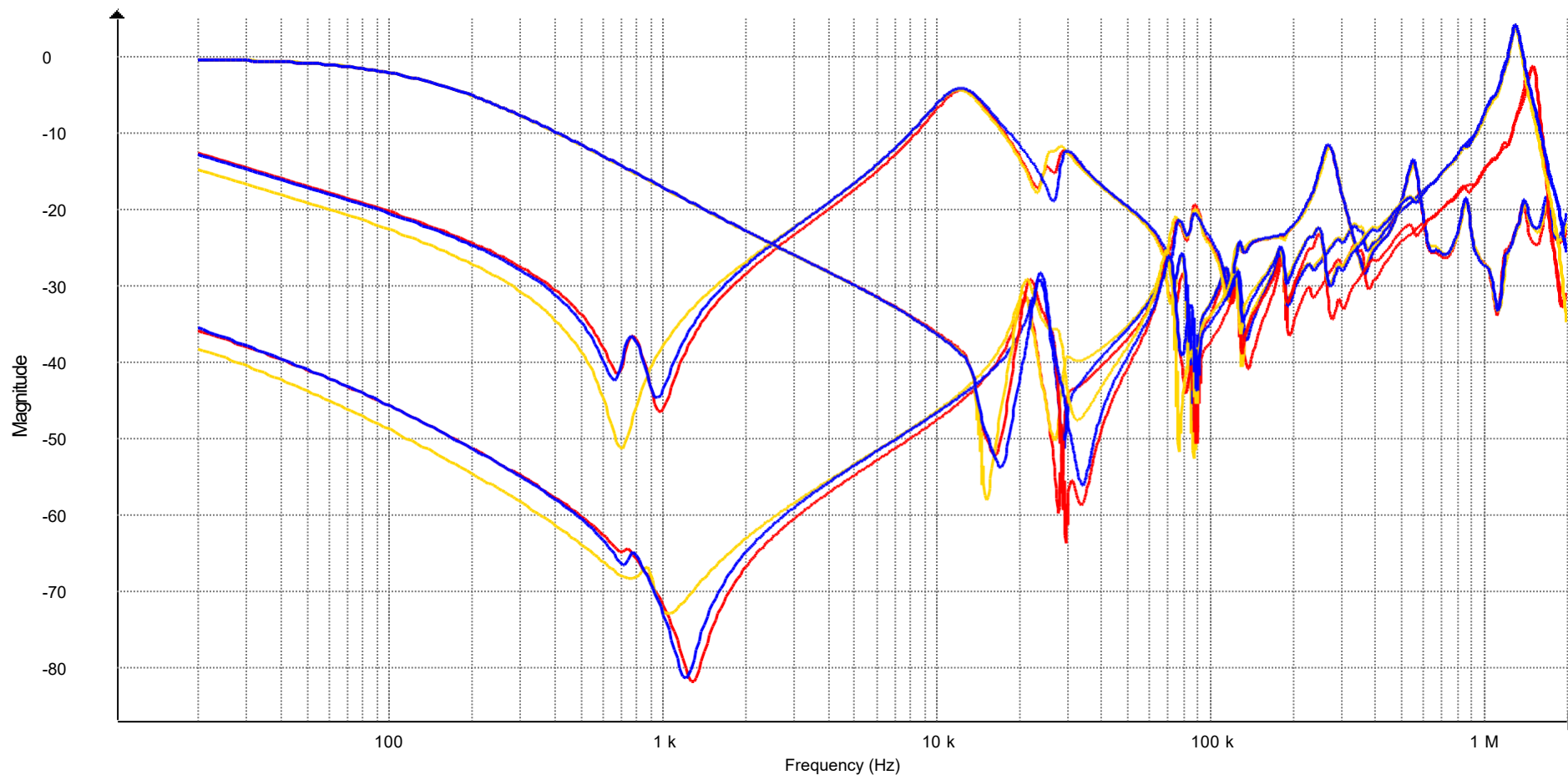
Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

Manufacturer: MTM

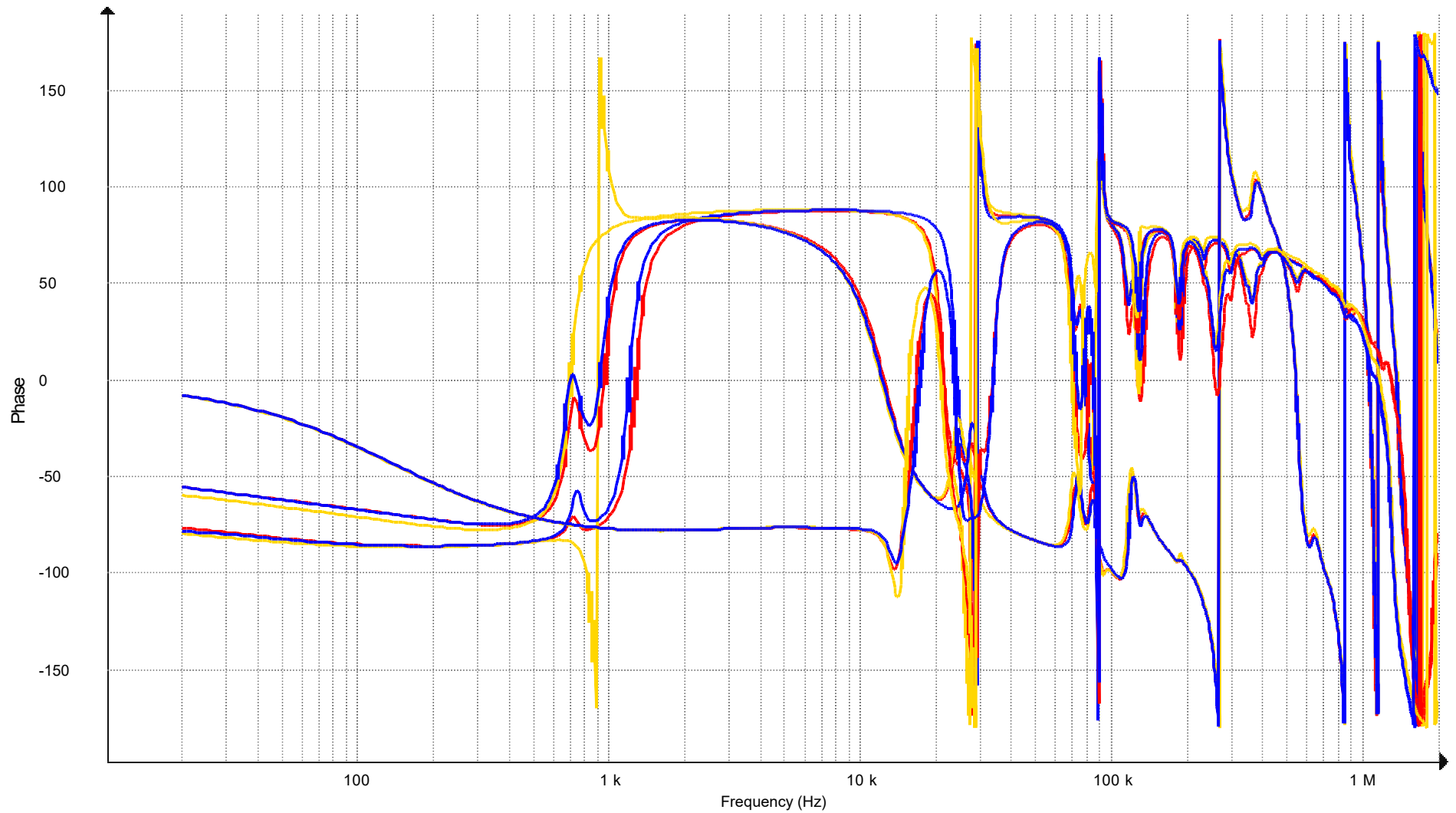
Tested by: VICKNESH

Magnitude:



[1u-1v [open, LTC=Max]] [1v-1w [open, LTC=Max]] [1w-1u [open, LTC=Max]] [2u-2n [open]] [2v-2n [open]] [2w-2n [open]]
[1u-1v [short 2u-2v-2w, LTC=Max]] [1v-1w [short 2u-2v-2w, LTC=Max]] [1w-1u [short 2u-2v-2w, LTC=Max]]

Phase:



[1u-1v [open, LTC=Max]] [1v-1w [open, LTC=Max]] [1w-1u [open, LTC=Max]] [2u-2n [open]] [2v-2n [open]] [2w-2n [open]]
[1u-1v [short 2u-2v-2w, LTC=Max]] [1v-1w [short 2u-2v-2w, LTC=Max]] [1w-1u [short 2u-2v-2w, LTC=Max]]

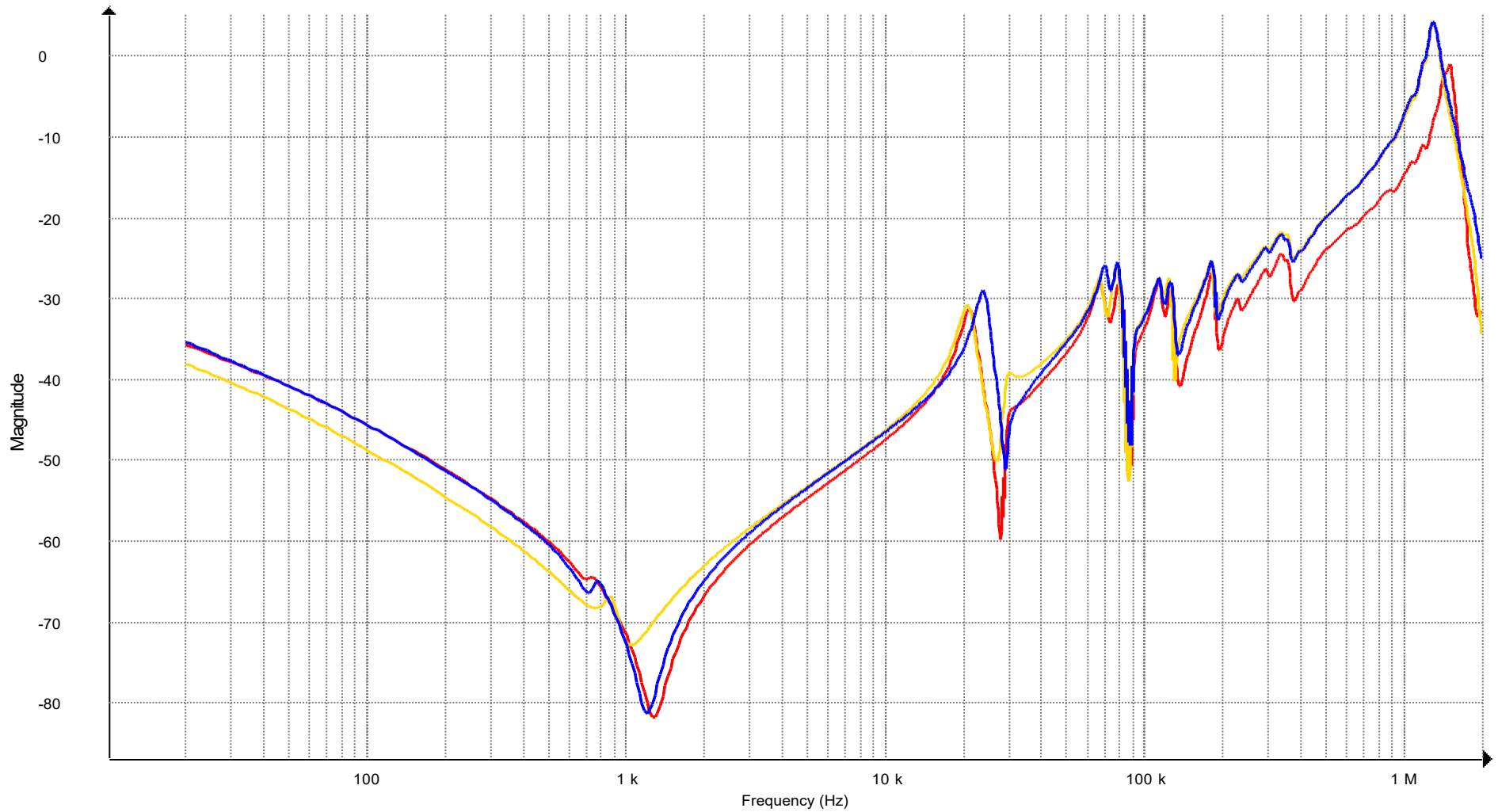
Designation: "PERAK" at "PPU PENGKALAN HULU T2 AFTER"

Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

Manufacturer: MTM

Tested by: VICKNESH



[1u-1v [open, LTC=Max]] [1v-1w [open, LTC=Max]] [1w-1u [open, LTC=Max]]

Designation: "PERAK" at "PPU PENGKALAN HULU T2 AFTER"

Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

Manufacturer: MTM

Tested by: VICKNESH



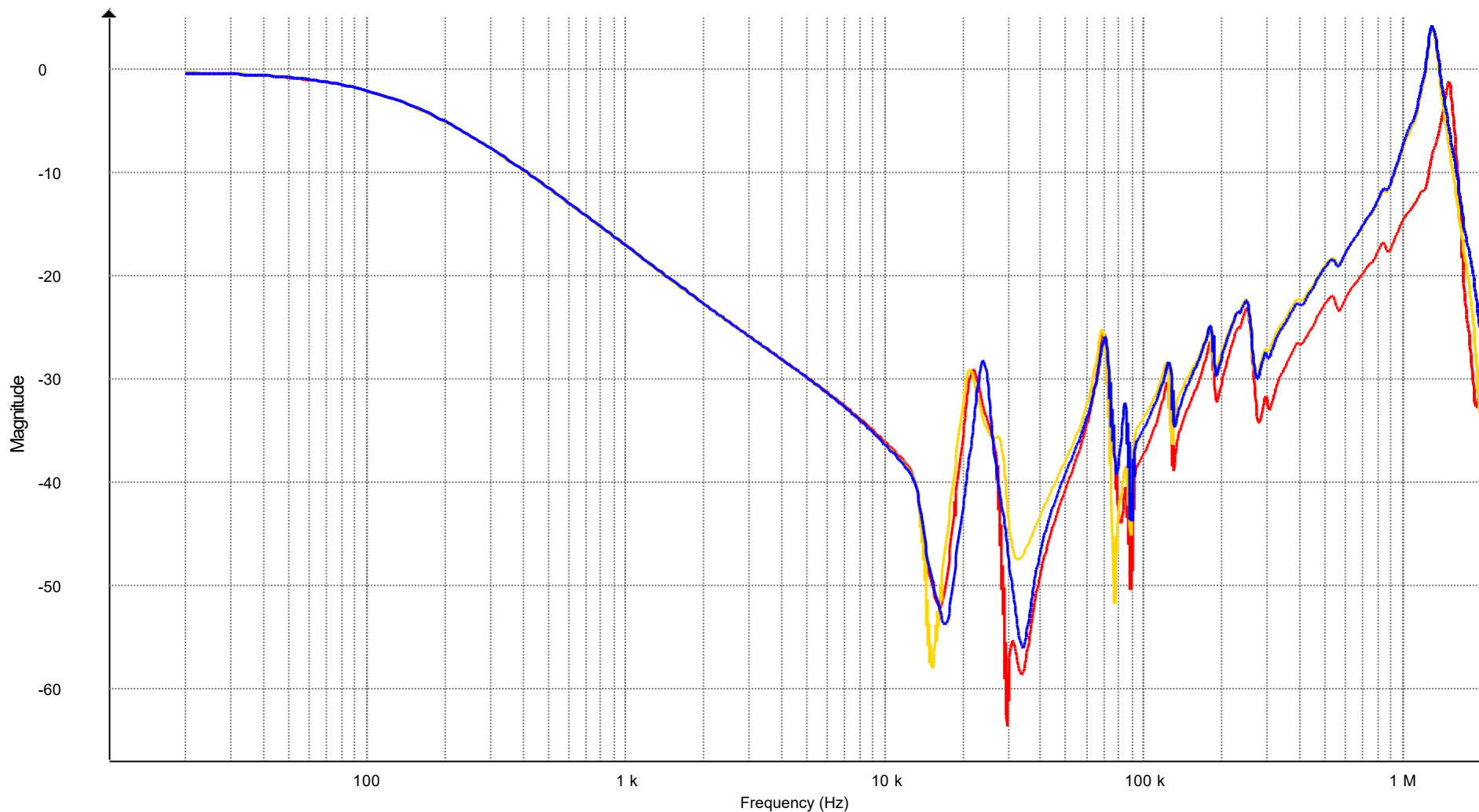
Designation: "PERAK" at "PPU PENGKALAN HULU T2 AFTER"

Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

Manufacturer: MTM

Tested by: VICKNESH



[1u-1v [short 2u-2v-2w, LTC=Max]]

[1v-1w [short 2u-2v-2w, LTC=Max]]

[1w-1u [short 2u-2v-2w, LTC=Max]]

DL/T 911-2004 Analyzer

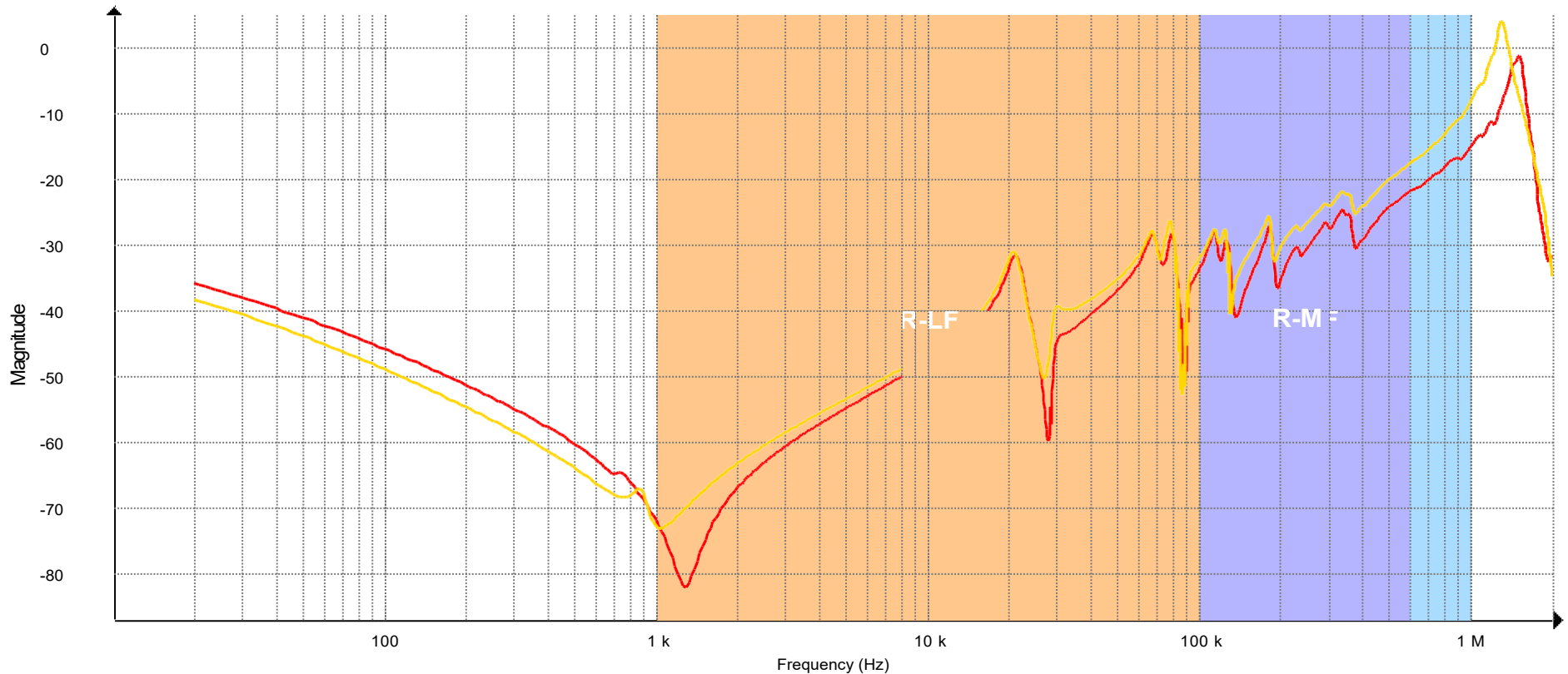
Designation: PERAK at PPU PENGKALAN HULU T2 AFTER

Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

Manufacturer: MTM

Tested by: VICKNESH



— [1u-1v [open, LTC=Max]] — [1v-1w [open, LTC=Max]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1u-1v [open, LTC=Max]] – [1v-1w [open, LTC=Max]]	1.76	1.16	2.10	Light Distortion
R ₂₃	[1v-1w [open, LTC=Max]] – [1w-1u [open, LTC=Max]]	1.35	1.65	4.06	Light Distortion
R ₃₁	[1w-1u [open, LTC=Max]] – [1u-1v [open, LTC=Max]]	1.49	1.49	2.06	Light Distortion

DL/T 911-2004 Analyzer

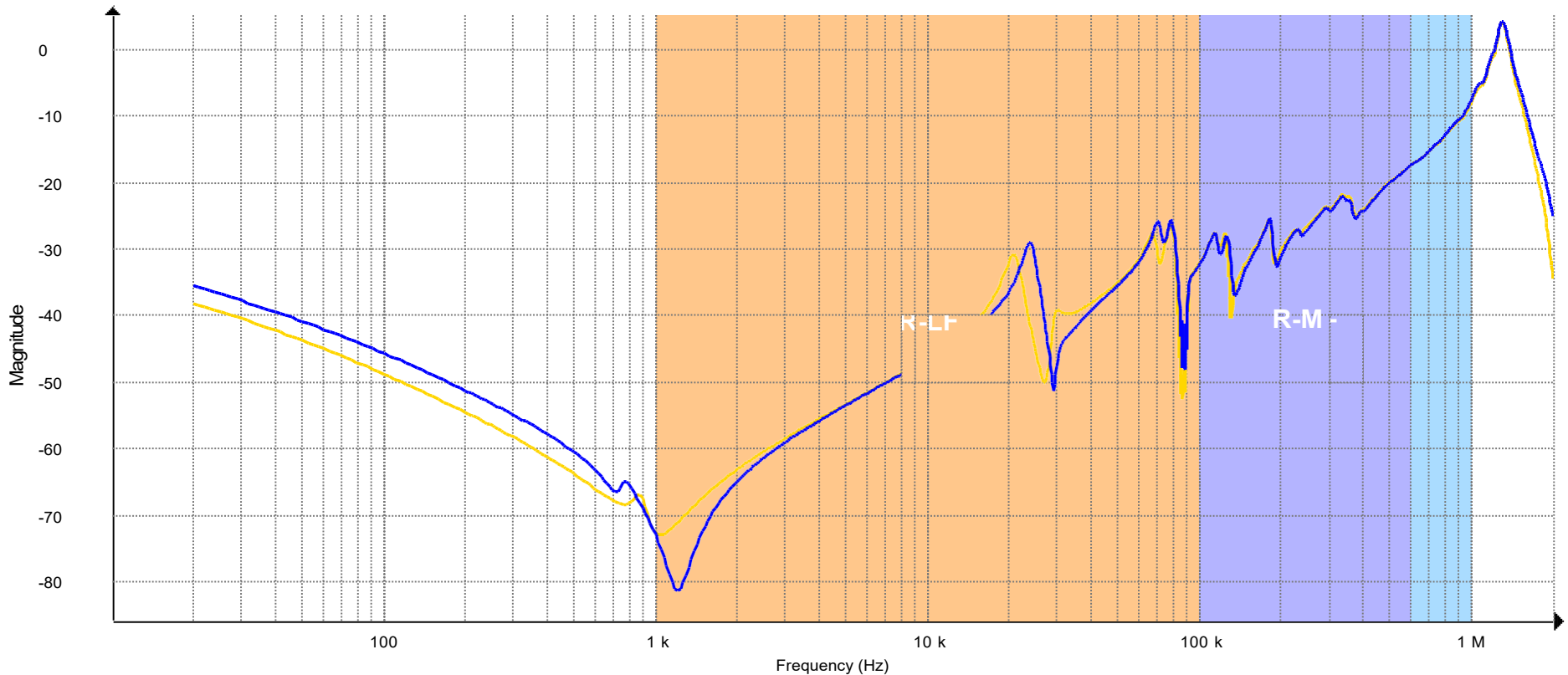
Designation: PERAK at PPU PENGKALAN HULU T2 AFTER

Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

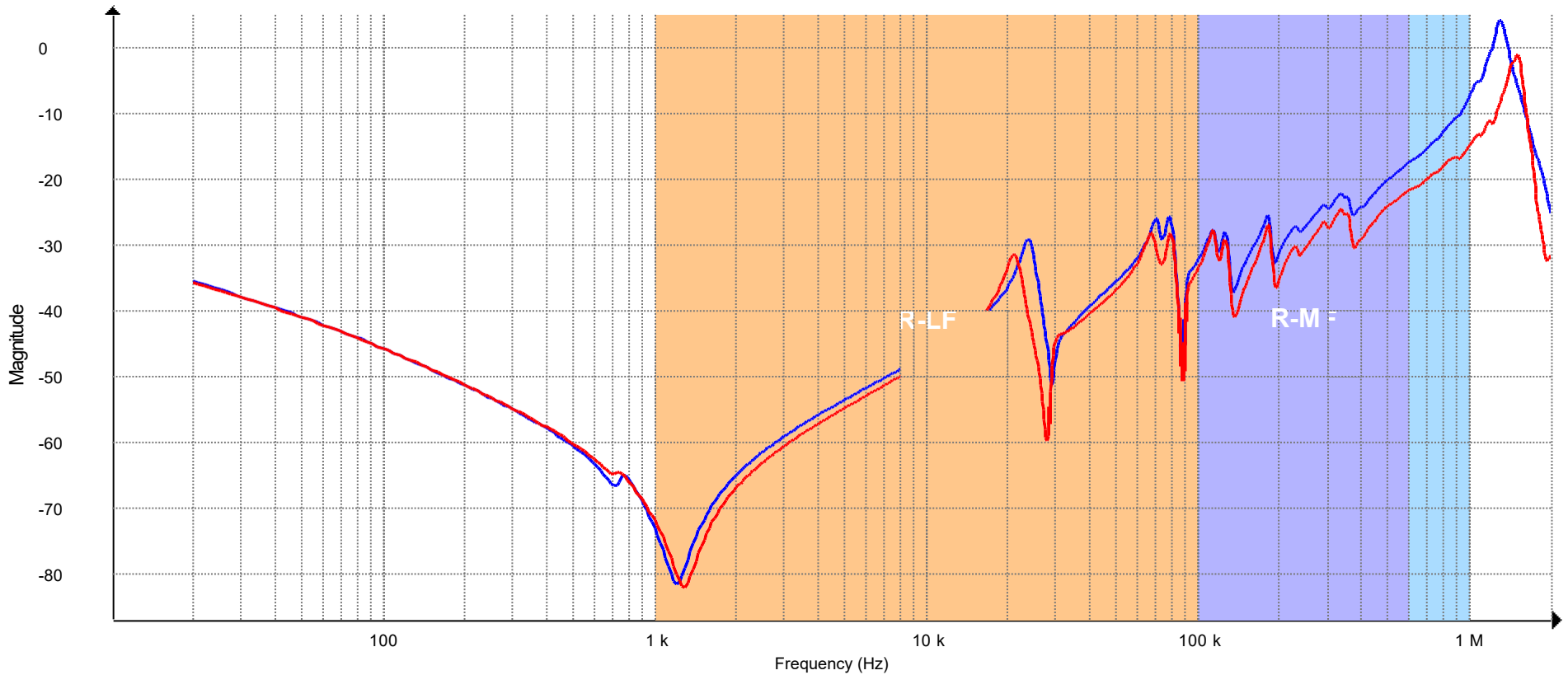
Manufacturer: MTM

Tested by: VICKNESH



— [1v-1w [open, LTC=Max]] — [1w-1u [open, LTC=Max]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1v-1w [open, LTC=Max]] – [1w-1u [open, LTC=Max]]	1.35	1.65	4.06	Light Distortion
R ₂₃	[1w-1u [open, LTC=Max]] – [1u-1v [open, LTC=Max]]	1.49	1.49	2.06	Light Distortion
R ₃₁	[1u-1v [open, LTC=Max]] – [1v-1w [open, LTC=Max]]	1.76	1.16	2.10	Light Distortion

DL/T 911-2004 Analyzer**Designation:** PERAK at PPU PENGKALAN HULU T2 AFTER**Serial Number:** P/320/07/15010**Tested 4/8/2024 at 10:13:49****Manufacturer:** MTM**Tested by:** VICKNESH

— [1w-1u [open, LTC=Max]] — [1u-1v [open, LTC=Max]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1w-1u [open, LTC=Max]] – [1u-1v [open, LTC=Max]]	1.49	1.49	2.06	Light Distortion
R ₂₃	[1u-1v [open, LTC=Max]] – [1v-1w [open, LTC=Max]]	1.76	1.16	2.10	Light Distortion
R ₃₁	[1v-1w [open, LTC=Max]] – [1w-1u [open, LTC=Max]]	1.35	1.65	4.06	Light Distortion

DL/T 911-2004 Analyzer

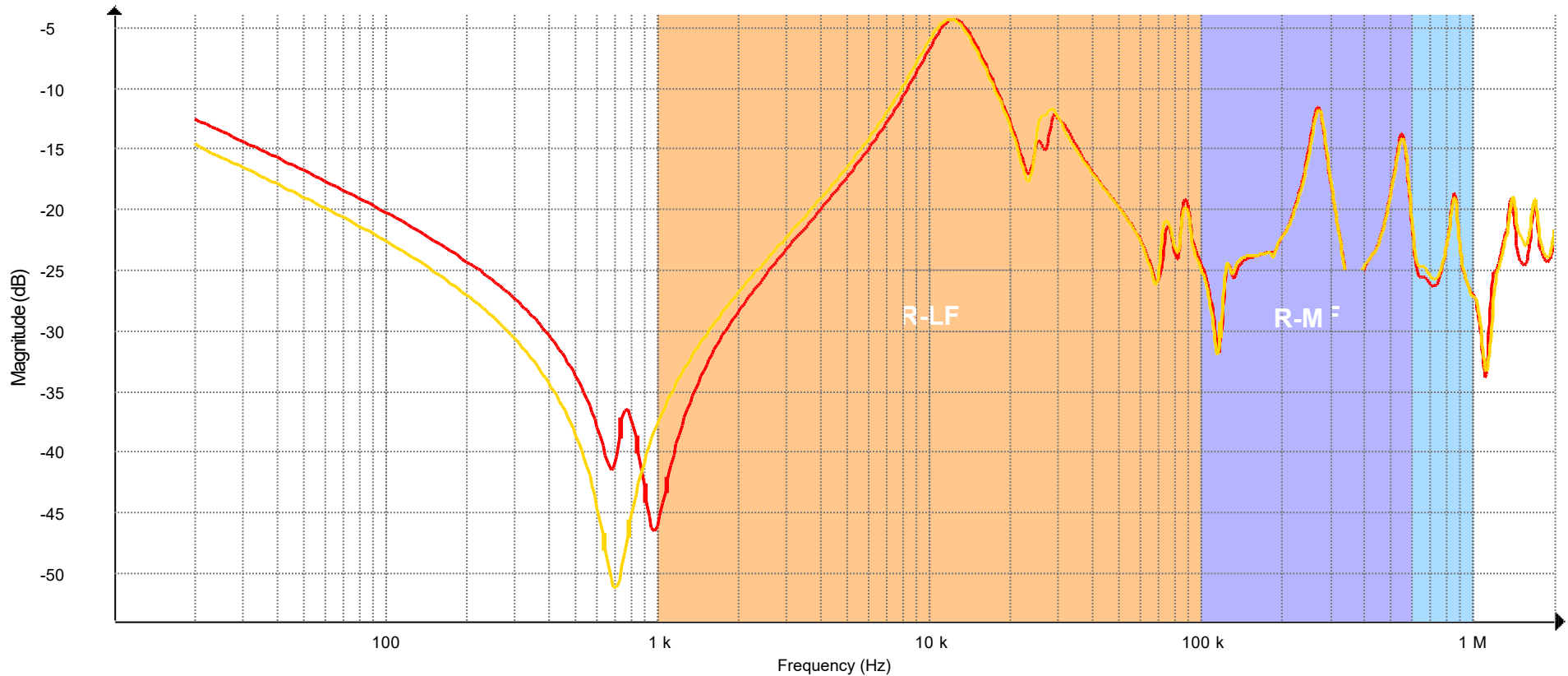
Designation: PERAK at PPU PENGKALAN HULU T2 AFTER

Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

Manufacturer: MTM

Tested by: VICKNESH



— [2u-2n [open]] — [2v-2n [open]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[2u-2n [open]] – [2v-2n [open]]	1.99	2.51	1.96	Light Distortion
R ₂₃	[2v-2n [open]] – [2w-2n [open]]	1.69	2.01	2.10	Light Distortion
R ₃₁	[2w-2n [open]] – [2u-2n [open]]	2.07	2.56	1.99	Normal

DL/T 911-2004 Analyzer

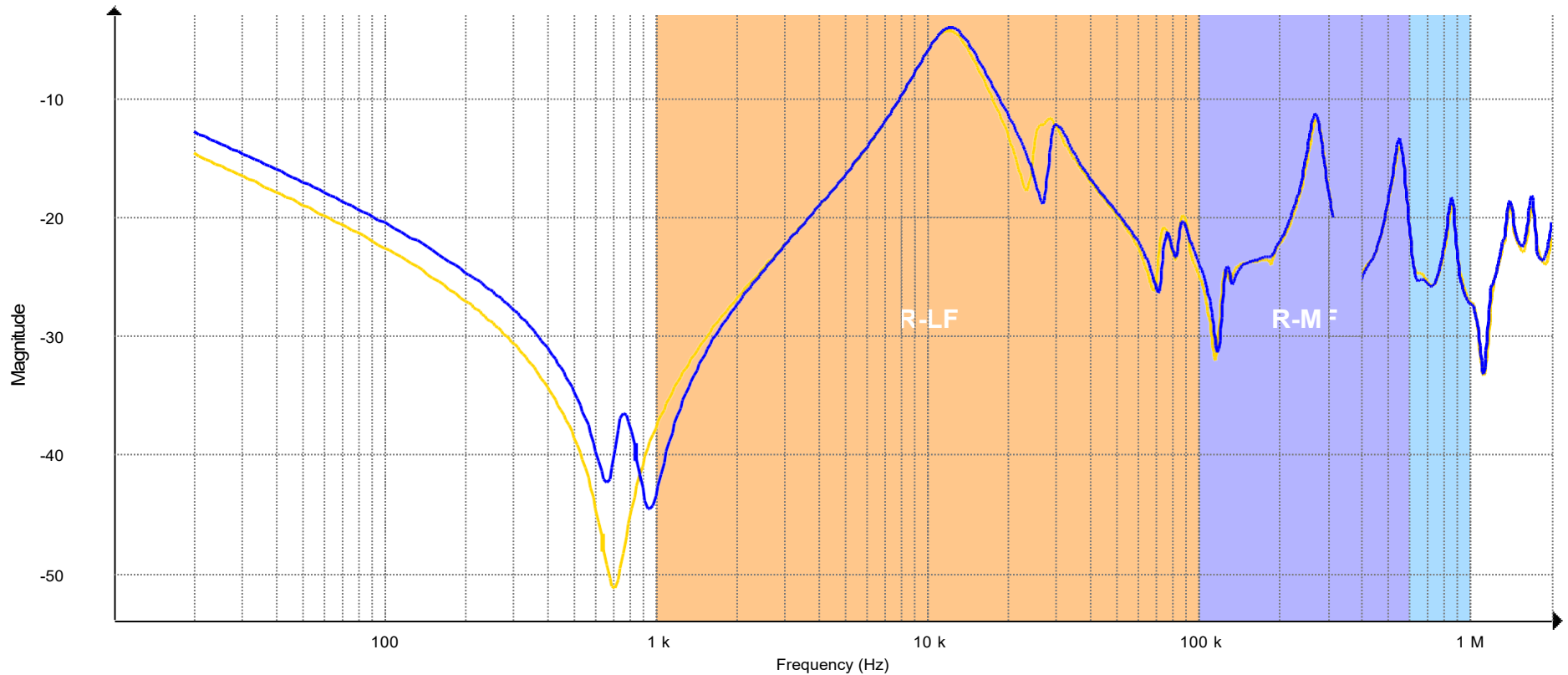
Designation: PERAK at PPU PENGKALAN HULU T2 AFTER

Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

Manufacturer: MTM

Tested by: VICKNESH



— [2v-2n [open]] — [2w-2n [open]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[2v-2n [open]] – [2w-2n [open]]	1.69	2.01	2.10	Light Distortion
R ₂₃	[2w-2n [open]] – [2u-2n [open]]	2.07	2.56	1.99	Normal
R ₃₁	[2u-2n [open]] – [2v-2n [open]]	1.99	2.51	1.96	Light Distortion

DL/T 911-2004 Analyzer

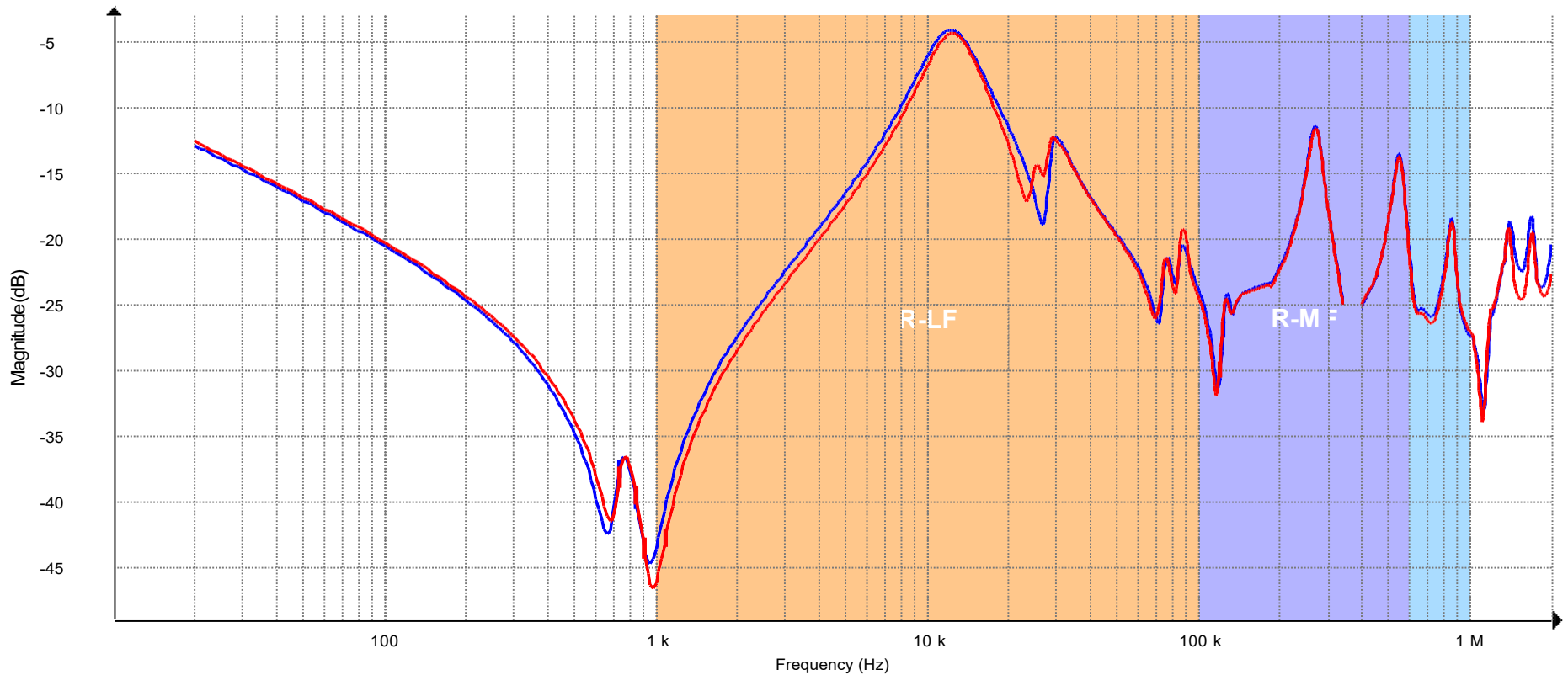
Designation: PERAK at PPU PENGKALAN HULU T2 AFTER

Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

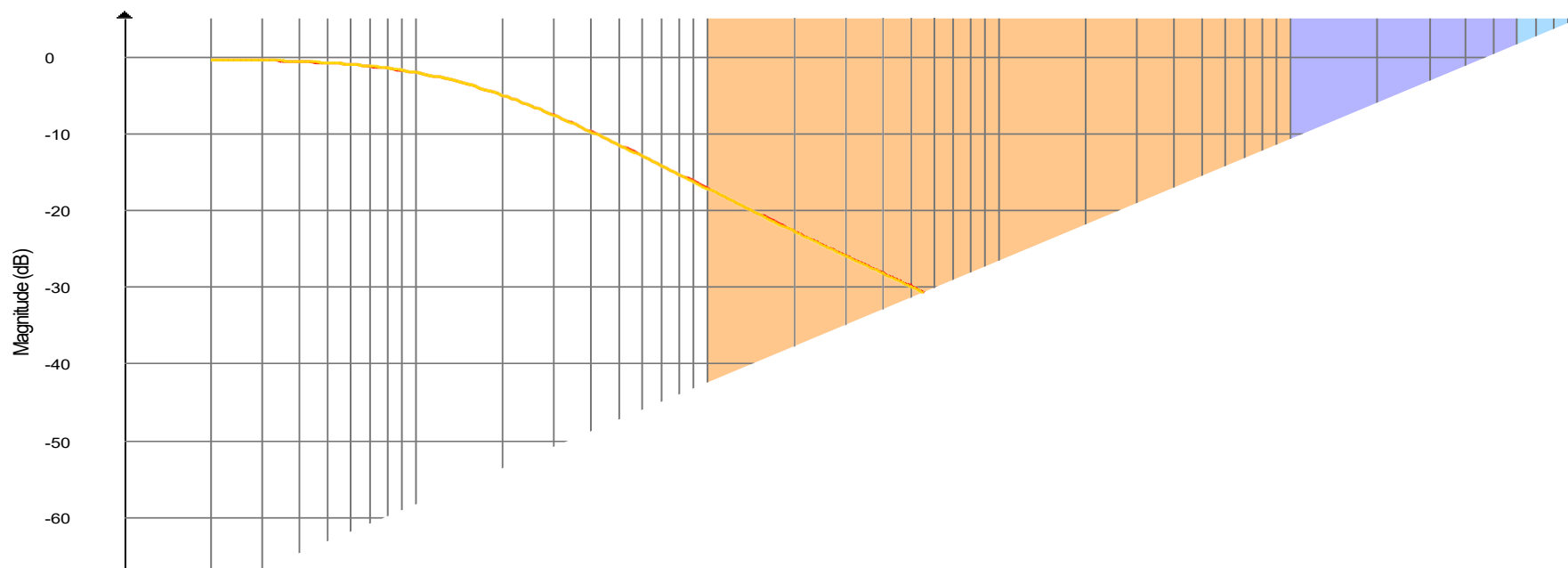
Manufacturer: MTM

Tested by: VICKNESH



— [2w-2n [open]] — [2u-2n [open]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[2w-2n [open]] – [2u-2n [open]]	2.07	2.56	1.99	Normal
R ₂₃	[2u-2n [open]] – [2v-2n [open]]	1.99	2.51	1.96	Light Distortion
R ₃₁	[2v-2n [open]] – [2w-2n [open]]	1.69	2.01	2.10	Light Distortion

DL/T 911-2004 Analyzer**Designation:** PERAK at PPU PENGKALAN HULU T2 AFTER**Serial Number:** P/320/07/15010**Tested** 4/8/2024 at 10:13:49**Manufacturer:** MTM**Tested by:** VICKNESH

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1u-1v [short 2u-2v-2w, LTC=Max]] – [1v-1w [short 2u-2v-2w, LTC=Max]]	1.10	1.28	1.88	Light Distortion
R ₂₃	[1v-1w [short 2u-2v-2w, LTC=Max]] – [1w-1u [short 2u-2v-2w, LTC=Max]]	1.06	1.86	4.25	Light Distortion
R ₃₁	[1w-1u [short 2u-2v-2w, LTC=Max]] – [1u-1v [short 2u-2v-2w, LTC=Max]]	1.33	1.42	1.94	Light Distortion

DL/T 911-2004 Analyzer

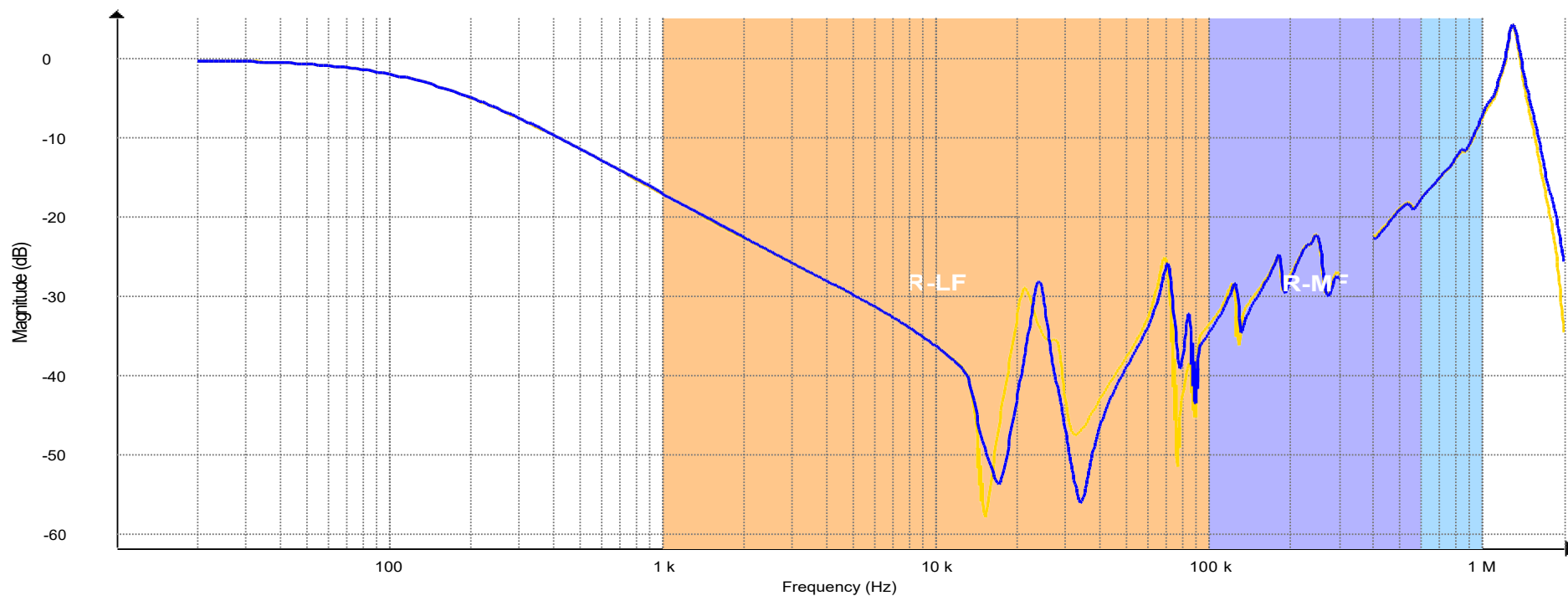
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Serial Number: P/320/07/15010

Tested 4/8/2024 at 10:13:49

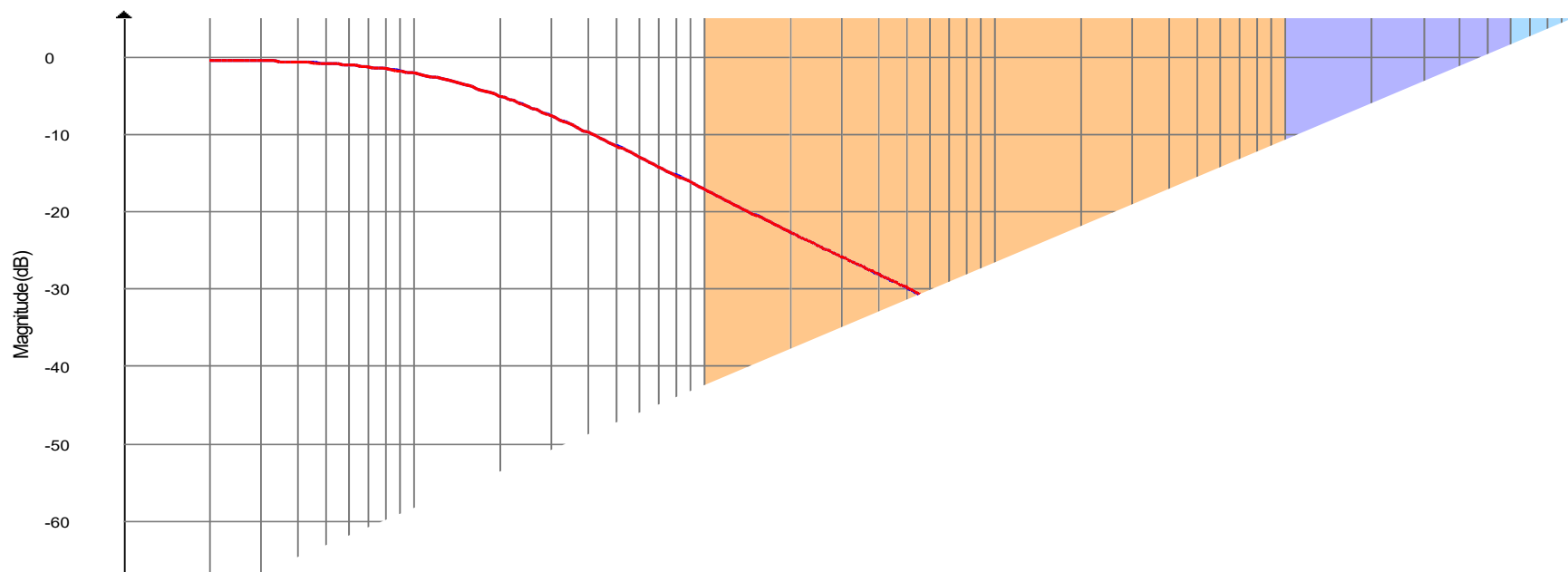
Manufacturer: MTM

Tested by: VICKNESH



— [1v-1w [short 2u-2v-2w, LTC=Max]] — [1w-1u [short 2u-2v-2w, LTC=Max]]

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1v-1w [short 2u-2v-2w, LTC=Max]] – [1w-1u [short 2u-2v-2w, LTC=Max]]	1.06	1.86	4.25	Light Distortion
R ₂₃	[1w-1u [short 2u-2v-2w, LTC=Max]] – [1u-1v [short 2u-2v-2w, LTC=Max]]	1.33	1.42	1.94	Light Distortion
R ₃₁	[1u-1v [short 2u-2v-2w, LTC=Max]] – [1v-1w [short 2u-2v-2w, LTC=Max]]	1.10	1.28	1.88	Light Distortion

DL/T 911-2004 Analyzer**Designation:** PERAK at PPU PENGKALAN HULU T2 AFTER**Serial Number:** P/320/07/15010**Tested** 4/8/2024 at 10:13:49**Manufacturer:** MTM**Tested by:** VICKNESH

	Name	R _{LF}	R _{MF}	R _{HF}	
R ₁₂	[1w-1u [short 2u-2v-2w, LTC=Max]] – [1u-1v [short 2u-2v-2w, LTC=Max]]	1.33	1.42	1.94	Light Distortion
R ₂₃	[1u-1v [short 2u-2v-2w, LTC=Max]] – [1v-1w [short 2u-2v-2w, LTC=Max]]	1.10	1.28	1.88	Light Distortion
R ₃₁	[1v-1w [short 2u-2v-2w, LTC=Max]] – [1w-1u [short 2u-2v-2w, LTC=Max]]	1.06	1.86	4.25	Light Distortion



TRANSFORMER FREQUENCY DOMAIN SPECTROSCOPY (FDS) TEST REPORT

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

IDAX Measurement Report

General

Company:	MTM
Division:	PERAK
Location:	PPU PENGKALAN HULU
Date:	4/8/2024

Test conditions

Ambient temperature, °C:	34
Ambient %RH:	70
Object temperature, °C:	36
Weather:	SUNNY
Tester:	VICKNESH

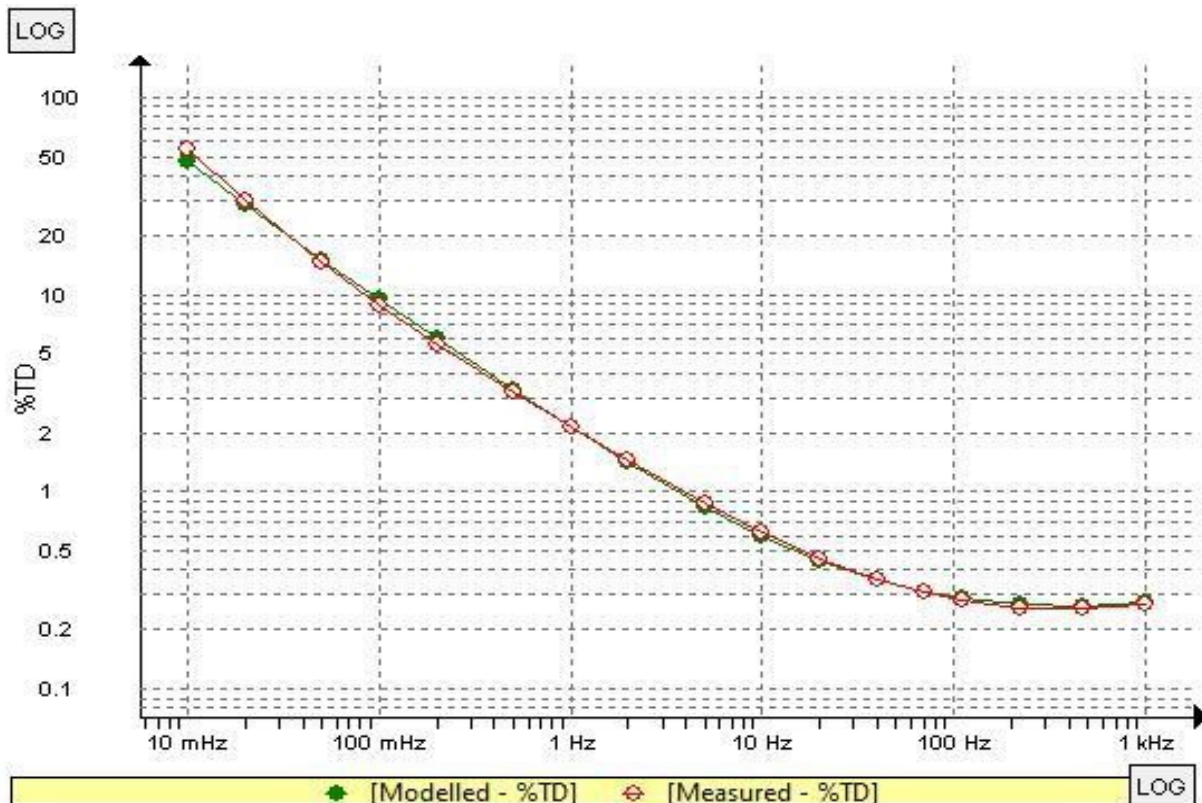
Test object information

Test object:	Two Winding Transformer
Designation:	PPU PENGKALAN HULU T2 AFTER
Manufacturer:	MTM
Type:	15-201
Core type:	Core
Serial no:	P/320/07/15010
Coolant:	Mineral Oil
Cooling class:	ONAN/ONAF
Voltage (kV):	33/11
MVA:	15
Vector group:	DYN11
Frequency:	50

Insulation assessment(CHG)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CHG	140	50	2322	0.338	0.268

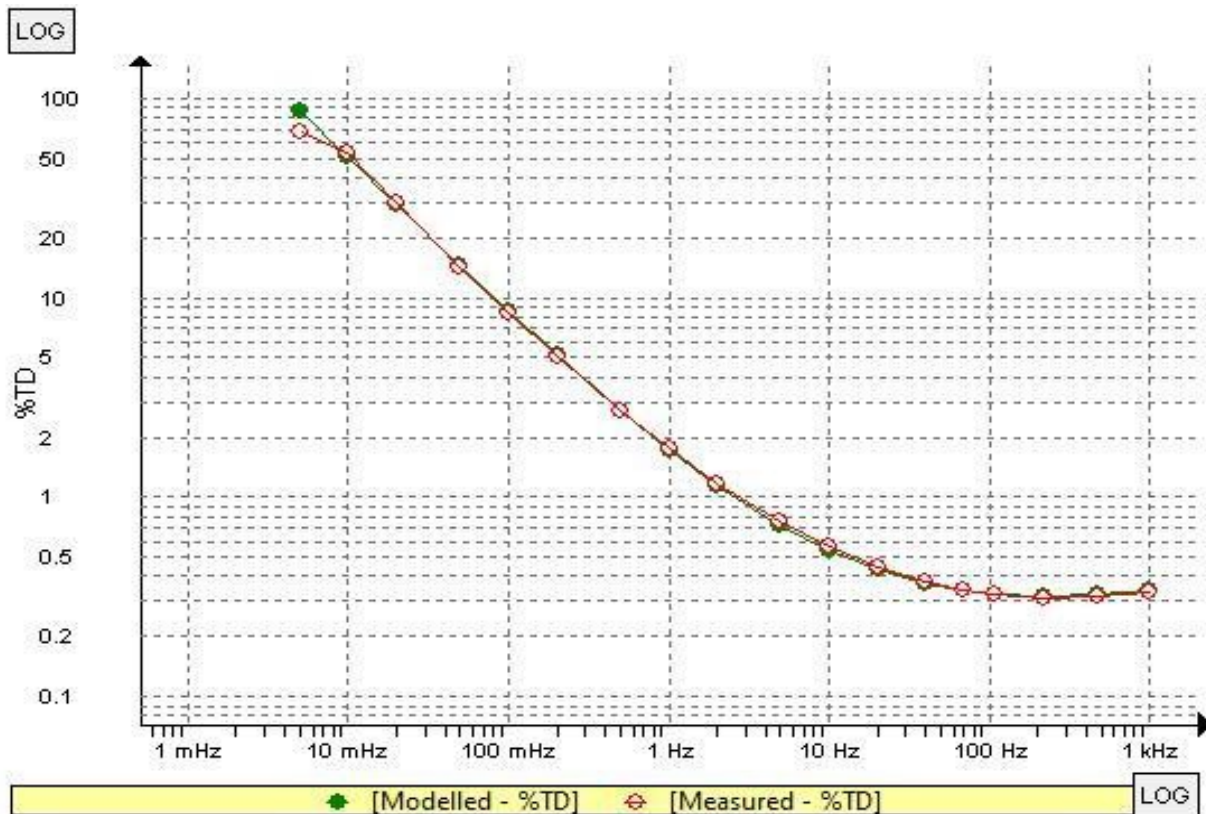
Analysis results		
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.268	2.5	0.004
< 0.30 % As new	< 1.0 % As new	< 0.0060 % As new
0.30 - 0.50 % Good	1.0 - 2.0 % Dry	0.0060 - 0.060 % Good
0.50 - 1.0 % Deteriorated	2.0 - 3.0 % Moderately wet	0.060 - 0.60 % Service aged
> 1.0 % Investigate	> 3.0 % Wet	> 0.60 % Deteriorated



Insulation assessment(CHL)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CHL	140	50	5630	0.360	0.327

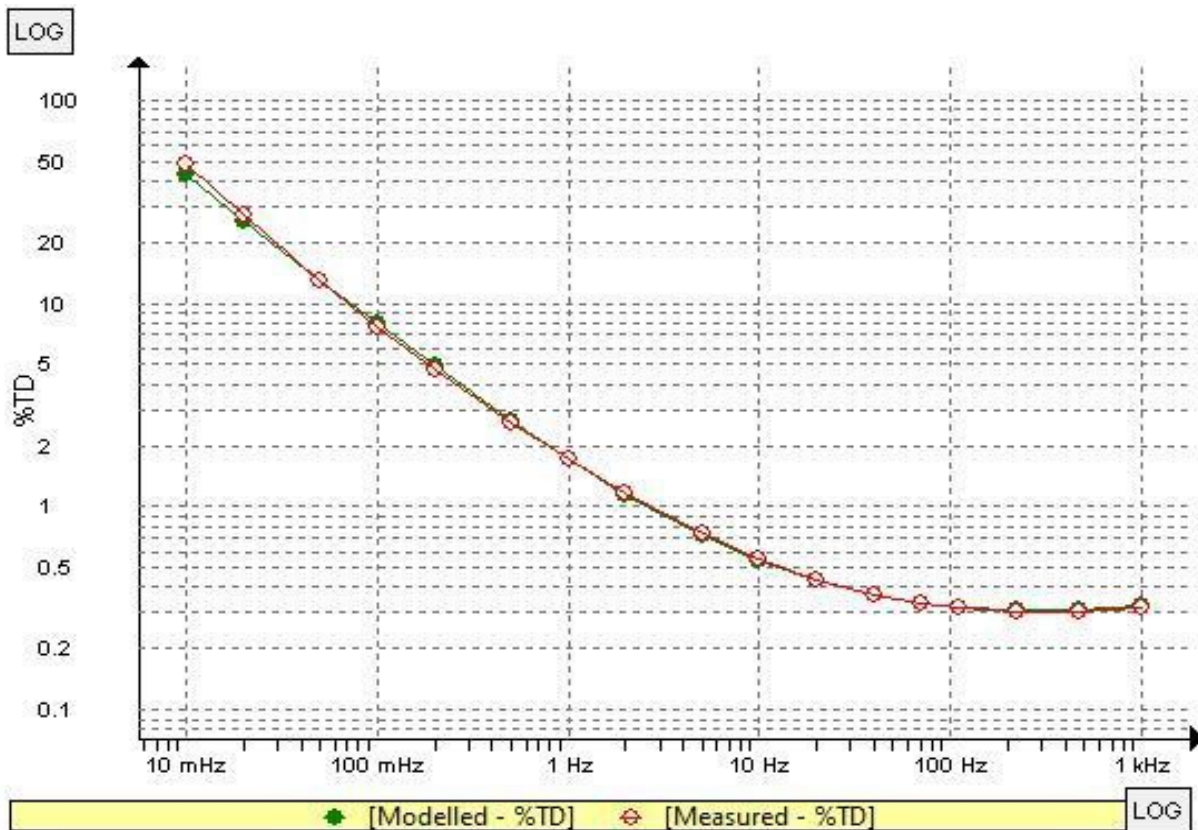
Analysis results		
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.327	2.0	0.007
< 0.30 % As new	< 1.0 % As new	< 0.0060 % As new
0.30 - 0.50 % Good	1.0 - 2.0 % Dry	0.0060 - 0.060 % Good
0.50 - 1.0 % Deteriorated	2.0 - 3.0 % Moderately wet	0.060 - 0.60 % Service aged
> 1.0 % Investigate	> 3.0 % Wet	> 0.60 % Deteriorated



Insulation assessment(CLG)

Measurement	Voltage (Vrms)	Freq (Hz)	C (pF)	%TD meas	%TD @ 20°C
CLG	140	50	6822	0.353	0.313

Analysis results		
%TD @ 50 Hz & 20°C	Moisture %(wt/wt)	Liquid %TD @ 50 Hz & 25°C
0.313	2.1	0.005
< 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



PPU PENGKALAN HULU T2 AFTER 2024-08-04 10.16

CHG - (4/8/2024 11:08:42 AM)

TEST MODE	HUM (50Hz)	OFFSET	CAPACITANCE (930Hz, 140 (RMS))
UST-R	15 nA	1.4 nA	5.6 nF
UST-B	---	---	---
UST-RB	15 nA*	1.4 nA*	5.6 nF*
GST-G	1.2 nA*	-1.2 nA*	7.9 nF
GSTG-R	17 nA*	129 pA*	2.3 nF*
GSTG-B	1.2 nA*	-1.2 nA*	7.9 nF*
GSTG-RB	17 nA	129 pA	2.3 nF

*ESTIMATED FROM MEASUREMENTS OF OTHER TEST MODES

HUM CURRENT IS PEAK VALUE OF THE FUNDAMENTAL

1000	2.31135E-09	6.18341E-12	0.267524	0.267523
470	2.31394E-09	5.90944E-12	0.255384	0.255384
220	2.31661E-09	5.96281E-12	0.257394	0.257393
110	2.31898E-09	6.49931E-12	0.280266	0.280265
70	2.32062E-09	7.14673E-12	0.307967	0.307965
40	2.32286E-09	8.3709E-12	0.360371	0.360369
20	2.32617E-09	1.07402E-11	0.461714	0.461709
10	2.33032E-09	1.45685E-11	0.625171	0.625159
5	2.33585E-09	2.05656E-11	0.880434	0.8804

PPU PENGKALAN HULU T2 AFTER IDAX.doc

2	2.34678E-09	3.39203E-11	1.4454	1.44525
1	2.35919E-09	5.04327E-11	2.13771	2.13722
0.5	2.37659E-09	7.58606E-11	3.19199	3.19037
0.2	2.40895E-09	1.33476E-10	5.54087	5.53238
0.1	2.44234E-09	2.14684E-10	8.79007	8.75631
0.05	2.4798E-09	3.60281E-10	14.5286	14.3777
0.02	2.56057E-09	7.71827E-10	30.1428	28.8602
0.01	2.62378E-09	1.4335E-09	54.635	47.9458

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CHL - (4/8/2024 10:58:48 AM)

TEST MODE	HUM (50Hz)	OFFSET	CAPACITANCE (930Hz, 140 (RMS))
UST-R	16 nA	6.5 pA	5.6 nF
UST-B	---	---	---
UST-RB	16 nA*	6.5 pA*	5.6 nF*
GST-G	1.9 nA*	-435 pA*	7.9 nF
GSTG-R	18 nA*	-428 pA*	2.3 nF*
GSTG-B	1.9 nA*	-435 pA*	7.9 nF*
GSTG-RB	18 nA	-428 pA	2.3 nF

*ESTIMATED FROM MEASUREMENTS OF OTHER TEST MODES

HUM CURRENT IS PEAK VALUE OF THE FUNDAMENTAL

1000	5.60041E-09	1.86895E-11	0.333717	0.333715
470	5.60698E-09	1.76982E-11	0.315646	0.315644
220	5.61456E-09	1.74459E-11	0.310726	0.310724

PPU PENGKALAN HULU T2 AFTER IDAX.doc

110	5.6216E-09	1.81407E-11	0.322697	0.322696
70	5.62656E-09	1.91139E-11	0.339708	0.339706
40	5.63288E-09	2.11182E-11	0.37491	0.374908
20	5.64135E-09	2.5181E-11	0.446365	0.44636
10	5.65125E-09	3.18522E-11	0.563632	0.563623
5	5.66351E-09	4.24965E-11	0.750357	0.750336
2	5.68485E-09	6.70209E-11	1.17894	1.17886
1	5.70691E-09	9.95613E-11	1.74457	1.74431
0.5	5.73713E-09	1.53799E-10	2.68076	2.6798
0.2	5.7951E-09	2.89653E-10	4.99825	4.99201
0.1	5.85891E-09	4.87059E-10	8.31312	8.28454
0.05	5.94838E-09	8.36912E-10	14.0696	13.9323
0.02	6.13485E-09	1.82605E-09	29.7653	28.5283
0.01	6.33564E-09	3.35365E-09	52.9331	46.7832
0.005	1.15321E-08	7.78245E-09	67.4851	55.9388

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CLG - (4/8/2024 11:15:10 AM)

TEST MODE	HUM (50Hz)	OFFSET	CAPACITANCE(930Hz, 140 (RMS))
UST-R	5.3 NA	79 PA	5.6 NF
UST-B	---	---	---
UST-RB	5.3 NA*	79 PA*	5.6 NF*
GST-G	12 NA*	-176 PA*	12 NF
GSTG-R	17 NA*	-96 PA*	6.8 NF*
GSTG-B	12 NA*	-176 PA*	12 NF*
GSTG-RB	17 NA	-96 PA	6.8 NF

PPU PENGKALAN HULU T2 AFTER IDAX.doc

*ESTIMATED FROM MEASUREMENTS OF OTHER TEST MODES

HUM CURRENT IS PEAK VALUE OF THE FUNDAMENTAL

1000	6.78466E-09	2.16271E-11	0.318765	0.318764
470	6.79382E-09	2.07684E-11	0.305695	0.305694
220	6.80343E-09	2.06536E-11	0.303577	0.303575
110	6.81195E-09	2.15287E-11	0.316043	0.316041
70	6.8179E-09	2.26696E-11	0.332502	0.3325
40	6.82543E-09	2.50425E-11	0.3669	0.366897
20	6.83534E-09	2.97078E-11	0.434621	0.434617
10	6.84695E-09	3.75667E-11	0.548664	0.548655
5	6.8612E-09	5.02739E-11	0.732728	0.732708
2	6.88653E-09	7.95202E-11	1.15472	1.15464
1	6.91338E-09	1.17989E-10	1.70668	1.70643
0.5	6.95031E-09	1.80154E-10	2.59202	2.59115
0.2	7.02043E-09	3.30884E-10	4.71316	4.70794
0.1	7.09436E-09	5.45268E-10	7.68594	7.66333
0.05	7.18411E-09	9.36823E-10	13.0402	12.9307
0.02	7.40035E-09	2.01067E-09	27.1699	26.2194
0.01	7.68098E-09	3.71297E-09	48.3397	43.5215



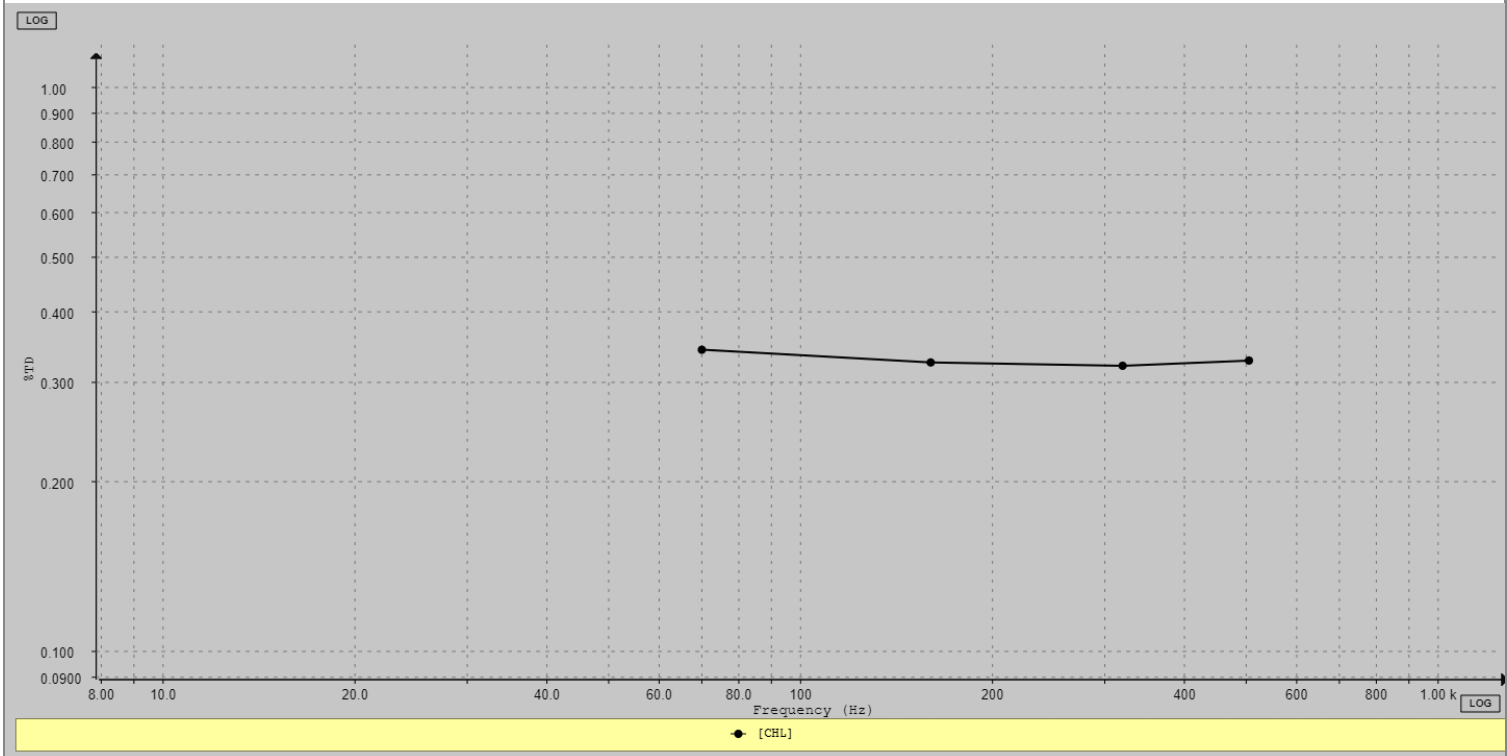
TRANSFORMER TANDELTA TEST REPORT

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



Tan Delta - Power Transformer

Designation	Test Mode	f (Hz)	U	I eq	C	%TD at 40 °C	T11 Corr. Factor	Corr. %TD to 20°C	P eq at 40 °C	% VDF
CHG + CHL	GST-GND	50.00	10.00 kV	24.99 mA	7.956 nF	0.358	0.890	0.319	894.7 mW	0.01 %
CHG	GSTg-RB	50.00	10.00 kV	7.310 mA	2.327 nF	0.345	0.890	0.307	252.3 mW	0.01 %
CHL	UST-R	50.00	10.00 kV	17.68 mA	5.629 nF	0.363	0.890	0.323	641.6 mW	0.01 %
CLG + CLH	GST-GND	50.00	6.600 kV	36.78 mA	11.71 nF	0.384	0.890	0.342	1.412 W	0.02 %
CLG	GSTg-RB	50.00	6.605 kV	19.10 mA	6.080 nF	0.407	0.890	0.362	776.6 mW	0.02 %
CLH	UST-R	50.00	6.604 kV	17.68 mA	5.629 nF	0.362	0.890	0.323	640.9 mW	0.01 %





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	36 310	50.00	10.03 kV	50.78 mA	1.057 kH	408.9 W
B-C	1	36 310	50.00	9.998 kV	14.61 mA	4.838 kH	130.5 W
C-A	1	36 310	50.00	10.00 kV	49.28 mA	1.137 kH	405.5 W
A-B	2	35 759	50.00	10.00 kV	52.12 mA	1.029 kH	419.4 W
B-C	2	35 759	50.00	10.00 kV	14.97 mA	4.795 kH	134.2 W
C-A	2	35 759	50.00	10.01 kV	50.55 mA	1.111 kH	416.4 W
A-B	3	35 207	50.00	10.02 kV	53.42 mA	1.006 kH	430.5 W
B-C	3	35 207	50.00	10.01 kV	15.34 mA	4.741 kH	137.9 W
C-A	3	35 207	50.00	9.984 kV	51.94 mA	1.085 kH	428.6 W
A-B	4	34 656	50.00	9.972 kV	54.93 mA	981.7 H	443.4 W
B-C	4	34 656	50.00	9.995 kV	15.74 mA	4.683 kH	142.0 W
C-A	4	34 656	50.00	9.983 kV	53.33 mA	1.061 kH	440.9 W
A-B	5	34 105	50.00	9.971 kV	56.41 mA	958.1 H	455.9 W
B-C	5	34 105	50.00	10.01 kV	16.15 mA	4.641 kH	146.2 W
C-A	5	34 105	50.00	9.984 kV	54.79 mA	1.037 kH	453.9 W
A-B	6	33 553	50.00	9.978 kV	57.90 mA	938.7 H	469.3 W
B-C	6	33 553	50.00	9.991 kV	16.58 mA	4.577 kH	150.5 W
C-A	6	33 553	50.00	9.984 kV	56.30 mA	1.014 kH	467.3 W
A-B	7	33 002	50.00	10.03 kV	59.35 mA	919.4 H	482.0 W
B-C	7	33 002	50.00	10.02 kV	17.02 mA	4.545 kH	155.1 W
C-A	7	33 002	50.00	10.00 kV	57.83 mA	993.2 H	481.3 W
A-B	8	32 451	50.00	10.04 kV	60.96 mA	899.8 H	496.5 W
B-C	8	32 451	50.00	9.978 kV	18.29 mA	3.593 kH	160.0 W
C-A	8	32 451	50.00	9.990 kV	59.52 mA	968.7 H	496.3 W
A-B	9	31 899	50.00	9.976 kV	63.66 mA	843.8 H	512.8 W
B-C	9	31 899	50.00	10.01 kV	18.79 mA	3.541 kH	165.0 W
C-A	9	31 899	50.00	10.01 kV	62.14 mA	902.2 H	511.6 W
A-B	10	31 348	50.00	10.04 kV	65.33 mA	827.1 H	528.0 W
B-C	10	31 348	50.00	9.972 kV	19.36 mA	3.468 kH	170.4 W
C-A	10	31 348	50.00	10.00 kV	64.02 mA	879.9 H	528.2 W
A-B	11	30 797	50.00	10.03 kV	67.27 mA	806.8 H	544.8 W
B-C	11	30 797	50.00	9.980 kV	19.92 mA	3.406 kH	175.9 W
C-A	11	30 797	50.00	10.01 kV	65.94 mA	858.1 H	545.2 W
A-B	12	30 245	50.00	9.981 kV	69.44 mA	782.6 H	562.8 W

Connection	Tap	Tap Voltage (V)	f (Hz)	U	I eq	L	P eq at 40 °C
B-C	12	30 245	50.00	10.01 kV	20.51 mA	3.356 kH	181.8 W
C-A	12	30 245	50.00	9.992 kV	68.05 mA	834.9 H	563.7 W
A-B	13	29 694	50.00	10.04 kV	71.38 mA	766.2 H	580.5 W
B-C	13	29 694	50.00	10.03 kV	21.12 mA	3.296 kH	187.9 W
C-A	13	29 694	50.00	9.978 kV	70.25 mA	811.7 H	582.8 W
A-B	14	29 143	50.00	9.973 kV	73.81 mA	744.1 H	601.4 W
B-C	14	29 143	50.00	10.00 kV	21.82 mA	3.231 kH	194.7 W
C-A	14	29 143	50.00	9.981 kV	72.51 mA	789.8 H	602.8 W
A-B	15	28 591	50.00	9.969 kV	76.18 mA	723.3 H	621.8 W
B-C	15	28 591	50.00	9.982 kV	22.55 mA	3.157 kH	201.7 W
C-A	15	28 591	50.00	9.987 kV	74.88 mA	768.7 H	623.8 W
A-B	16	28 040	50.00	9.964 kV	78.66 mA	703.8 H	643.6 W
B-C	16	28 040	50.00	9.986 kV	23.35 mA	3.097 kH	209.6 W
C-A	16	28 040	50.00	10.00 kV	77.42 mA	748.3 H	646.9 W

Comment:



TRANSFORMER TURNS RATIO TEST REPORT

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

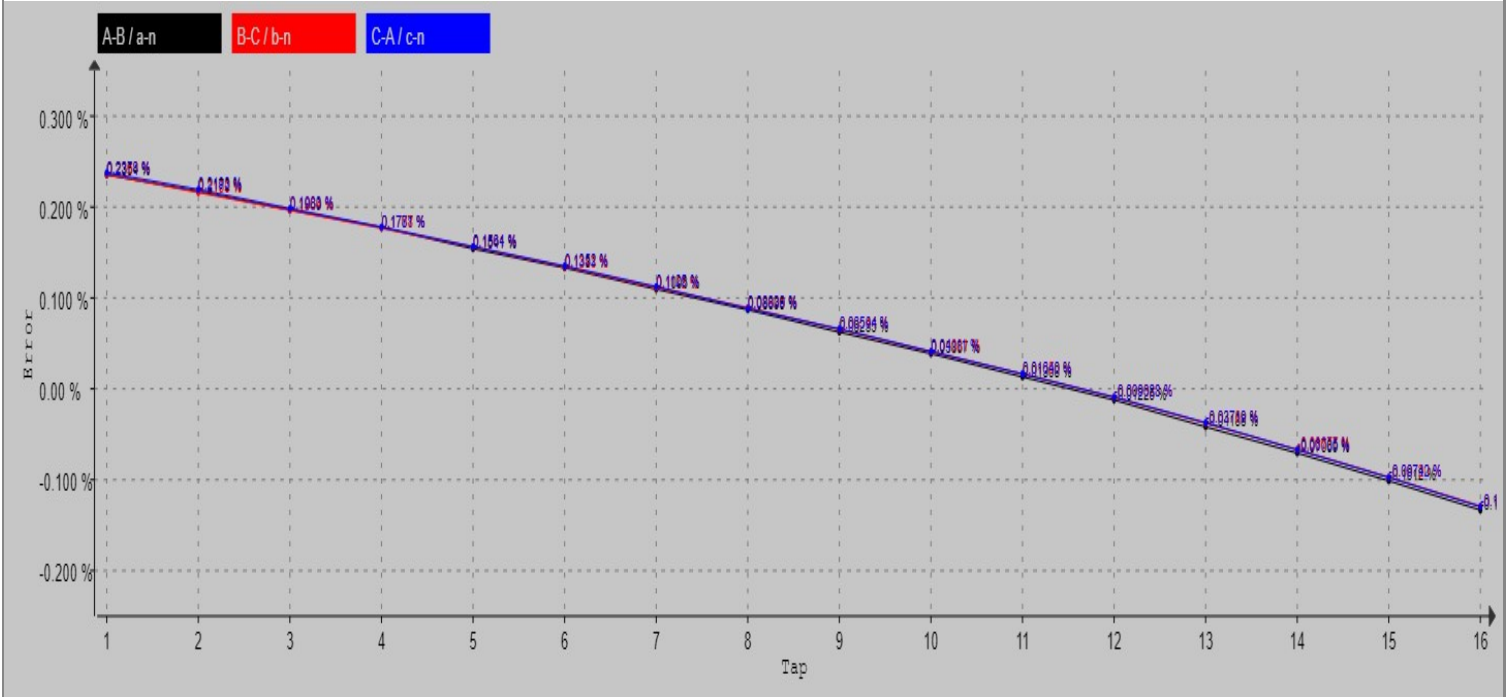


Turns ratio measurements

Connection	Tap (P)	Tap Voltage (V)	U	Test frequency	TTR	Measured TTR	Error	I Exc	Phase
A-B / a-n	1	36 310	125.0 V	50.00 Hz	5.717	5.731	0.24 %	2.571 mA	0.0 °
B-C / b-n	1	36 310	125.0 V	50.00 Hz	5.717	5.731	0.24 %	1.956 mA	0.0 °
C-A / c-n	1	36 310	125.0 V	50.00 Hz	5.717	5.731	0.24 %	2.687 mA	0.0 °
A-B / a-n	2	35 759	125.0 V	50.00 Hz	5.631	5.643	0.22 %	2.658 mA	0.0 °
B-C / b-n	2	35 759	125.0 V	50.00 Hz	5.631	5.643	0.22 %	2.002 mA	0.0 °
C-A / c-n	2	35 759	125.0 V	50.00 Hz	5.631	5.643	0.22 %	2.742 mA	0.0 °
A-B / a-n	3	35 207	125.0 V	50.00 Hz	5.544	5.555	0.20 %	2.717 mA	0.0 °
B-C / b-n	3	35 207	125.0 V	50.00 Hz	5.544	5.555	0.20 %	2.072 mA	0.0 °
C-A / c-n	3	35 207	125.0 V	50.00 Hz	5.544	5.555	0.20 %	2.832 mA	0.0 °
A-B / a-n	4	34 656	125.0 V	50.00 Hz	5.457	5.467	0.18 %	2.806 mA	0.0 °
B-C / b-n	4	34 656	125.0 V	50.00 Hz	5.457	5.467	0.18 %	2.115 mA	0.0 °
C-A / c-n	4	34 656	125.0 V	50.00 Hz	5.457	5.467	0.18 %	2.894 mA	0.0 °
A-B / a-n	5	34 105	125.0 V	50.00 Hz	5.370	5.378	0.15 %	2.878 mA	0.0 °
B-C / b-n	5	34 105	125.0 V	50.00 Hz	5.370	5.378	0.16 %	2.186 mA	0.0 °
C-A / c-n	5	34 105	125.0 V	50.00 Hz	5.370	5.378	0.16 %	2.982 mA	0.0 °
A-B / a-n	6	33 553	125.0 V	50.00 Hz	5.283	5.290	0.13 %	2.968 mA	0.0 °
B-C / b-n	6	33 553	125.0 V	50.00 Hz	5.283	5.290	0.13 %	2.247 mA	0.0 °
C-A / c-n	6	33 553	125.0 V	50.00 Hz	5.283	5.290	0.14 %	3.069 mA	0.0 °
A-B / a-n	7	33 002	125.0 V	50.00 Hz	5.196	5.202	0.11 %	3.055 mA	0.0 °
B-C / b-n	7	33 002	125.0 V	50.00 Hz	5.196	5.202	0.11 %	2.305 mA	0.0 °
C-A / c-n	7	33 002	125.0 V	50.00 Hz	5.196	5.202	0.11 %	3.146 mA	0.0 °
A-B / a-n	8	32 451	125.0 V	50.00 Hz	5.110	5.114	0.09 %	3.149 mA	0.0 °
B-C / b-n	8	32 451	125.0 V	50.00 Hz	5.110	5.114	0.09 %	2.388 mA	0.0 °
C-A / c-n	8	32 451	125.0 V	50.00 Hz	5.110	5.114	0.09 %	3.258 mA	0.0 °
A-B / a-n	9	31 899	125.0 V	50.00 Hz	5.023	5.026	0.06 %	3.251 mA	0.0 °
B-C / b-n	9	31 899	125.0 V	50.00 Hz	5.023	5.026	0.07 %	2.478 mA	0.0 °
C-A / c-n	9	31 899	125.0 V	50.00 Hz	5.023	5.026	0.07 %	3.342 mA	0.0 °
A-B / a-n	10	31 348	125.0 V	50.00 Hz	4.936	4.938	0.04 %	3.343 mA	0.0 °
B-C / b-n	10	31 348	125.0 V	50.00 Hz	4.936	4.938	0.04 %	2.546 mA	0.0 °
C-A / c-n	10	31 348	125.0 V	50.00 Hz	4.936	4.938	0.04 %	3.456 mA	0.0 °
A-B / a-n	11	30 797	125.0 V	50.00 Hz	4.849	4.850	0.01 %	3.456 mA	0.0 °
B-C / b-n	11	30 797	125.0 V	50.00 Hz	4.849	4.850	0.02 %	2.622 mA	0.0 °
C-A / c-n	11	30 797	125.0 V	50.00 Hz	4.849	4.850	0.02 %	3.551 mA	0.0 °
A-B / a-n	12	30 245	125.0 V	50.00 Hz	4.762	4.762	-0.01 %	3.557 mA	0.0 °
B-C / b-n	12	30 245	125.0 V	50.00 Hz	4.762	4.762	-0.01 %	2.716 mA	0.0 °
C-A / c-n	12	30 245	125.0 V	50.00 Hz	4.762	4.762	-0.01 %	3.653 mA	0.0 °
A-B / a-n	13	29 694	125.0 V	50.00 Hz	4.676	4.674	-0.04 %	3.679 mA	0.0 °

Connection	Tap (P)	Tap Voltage (V)	U	Test frequency	TTR	Measured TTR	Error	I Exc	Phase
B-C / b-n	13	29 694	125.0 V	50.00 Hz	4.676	4.674	-0.04 %	2.789 mA	0.0 °
C-A / c-n	13	29 694	125.0 V	50.00 Hz	4.676	4.674	-0.04 %	3.780 mA	0.0 °
A-B / a-n	14	29 143	125.0 V	50.00 Hz	4.589	4.586	-0.07 %	3.792 mA	0.0 °
B-C / b-n	14	29 143	125.0 V	50.00 Hz	4.589	4.586	-0.07 %	2.882 mA	0.0 °
C-A / c-n	14	29 143	125.0 V	50.00 Hz	4.589	4.586	-0.07 %	3.891 mA	0.0 °
A-B / a-n	15	28 591	125.0 V	50.00 Hz	4.502	4.497	-0.10 %	3.923 mA	0.0 °
B-C / b-n	15	28 591	125.0 V	50.00 Hz	4.502	4.498	-0.10 %	2.987 mA	0.0 °
C-A / c-n	15	28 591	125.0 V	50.00 Hz	4.502	4.498	-0.10 %	4.007 mA	0.0 °
A-B / a-n	16	28 040	125.0 V	50.00 Hz	4.415	4.409	-0.13 %	4.055 mA	0.0 °
B-C / b-n	16	28 040	125.0 V	50.00 Hz	4.415	4.409	-0.13 %	3.073 mA	0.0 °
C-A / c-n	16	28 040	125.0 V	50.00 Hz	4.415	4.409	-0.13 %	4.155 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.*

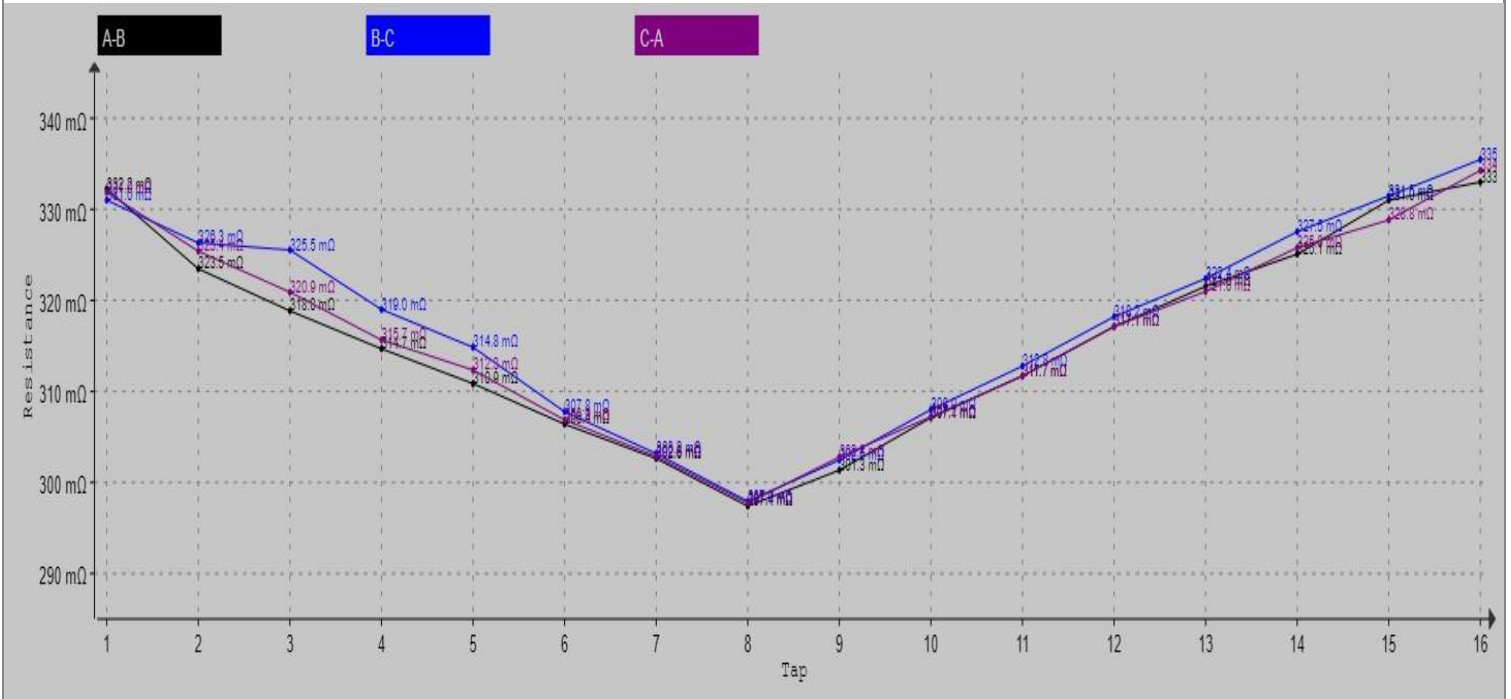


HV Winding resistance measurements

Connection	▼ Tap (P)	Current	40°C Resistance corrected to 75°C	Stability	Variation	Continuity
A-B	1	10.00 A	374.5 mΩ	99.27 %	---	✓
B-C	1	10.03 A	373.1 mΩ	99.83 %	---	✓
C-A	1	10.01 A	374.1 mΩ	99.58 %	0.37 %	✓
A-B	2	10.02 A	364.6 mΩ	99.62 %	---	✓
B-C	2	10.01 A	367.8 mΩ	99.85 %	---	✓
C-A	2	10.01 A	366.8 mΩ	99.68 %	0.88 %	✓
A-B	3	10.01 A	359.4 mΩ	99.82 %	---	✓
B-C	3	10.04 A	367.0 mΩ	99.29 %	---	✓
C-A	3	10.01 A	361.7 mΩ	99.42 %	2.08 %	✓
A-B	4	10.00 A	354.7 mΩ	99.97 %	---	✓
B-C	4	10.02 A	359.6 mΩ	99.82 %	---	✓
C-A	4	10.02 A	355.8 mΩ	99.85 %	1.37 %	✓
A-B	5	10.03 A	350.4 mΩ	99.74 %	---	✓
B-C	5	10.03 A	354.9 mΩ	99.47 %	---	✓
C-A	5	10.02 A	352.1 mΩ	99.50 %	1.28 %	✓
A-B	6	10.01 A	345.4 mΩ	99.58 %	---	✓
B-C	6	10.01 A	346.9 mΩ	99.55 %	---	✓
C-A	6	10.00 A	345.9 mΩ	99.49 %	0.44 %	✓
A-B	7	10.01 A	341.1 mΩ	99.52 %	---	✓
B-C	7	10.04 A	341.8 mΩ	99.64 %	---	✓
C-A	7	10.01 A	341.4 mΩ	99.47 %	0.18 %	✓
A-B	8	10.01 A	335.3 mΩ	99.83 %	---	✓
B-C	8	10.03 A	335.8 mΩ	99.88 %	---	✓
C-A	8	10.00 A	335.6 mΩ	99.94 %	0.18 %	✓
A-B	9	10.02 A	339.7 mΩ	99.54 %	---	✓
B-C	9	10.00 A	340.9 mΩ	99.02 %	---	✓
C-A	9	10.00 A	341.3 mΩ	99.30 %	0.48 %	✓
A-B	10	9.997 A	346.2 mΩ	99.45 %	---	✓
B-C	10	10.03 A	347.2 mΩ	99.73 %	---	✓
C-A	10	10.01 A	346.3 mΩ	99.74 %	0.29 %	✓
A-B	11	10.01 A	351.4 mΩ	99.29 %	---	✓
B-C	11	10.03 A	352.6 mΩ	99.82 %	---	✓
C-A	11	10.00 A	351.4 mΩ	99.60 %	0.35 %	✓
A-B	12	10.01 A	357.5 mΩ	99.64 %	---	✓
B-C	12	10.03 A	358.7 mΩ	99.91 %	---	✓
C-A	12	10.01 A	357.5 mΩ	99.60 %	0.34 %	✓
A-B	13	9.985 A	362.5 mΩ	99.20 %	---	✓

Connection	▼ Tap (P)	Current	40°C Resistance corrected to 75°C	Stability	Variation	Continuity
B-C	13	10.02 A	363.4 mΩ	99.90 %	---	✓
C-A	13	10.01 A	361.8 mΩ	99.86 %	0.44 %	✓
A-B	14	10.01 A	366.4 mΩ	99.72 %	---	✓
B-C	14	10.01 A	369.2 mΩ	99.84 %	---	✓
C-A	14	10.01 A	367.2 mΩ	99.67 %	0.76 %	✓
A-B	15	10.01 A	373.1 mΩ	99.21 %	---	✓
B-C	15	10.01 A	373.7 mΩ	99.79 %	---	✓
C-A	15	9.994 A	370.7 mΩ	99.61 %	0.80 %	✓
A-B	16	10.04 A	375.4 mΩ	99.48 %	---	✓
B-C	16	10.01 A	378.2 mΩ	99.79 %	---	✓
C-A	16	10.11 A	376.8 mΩ	99.43 %	0.74 %	✓

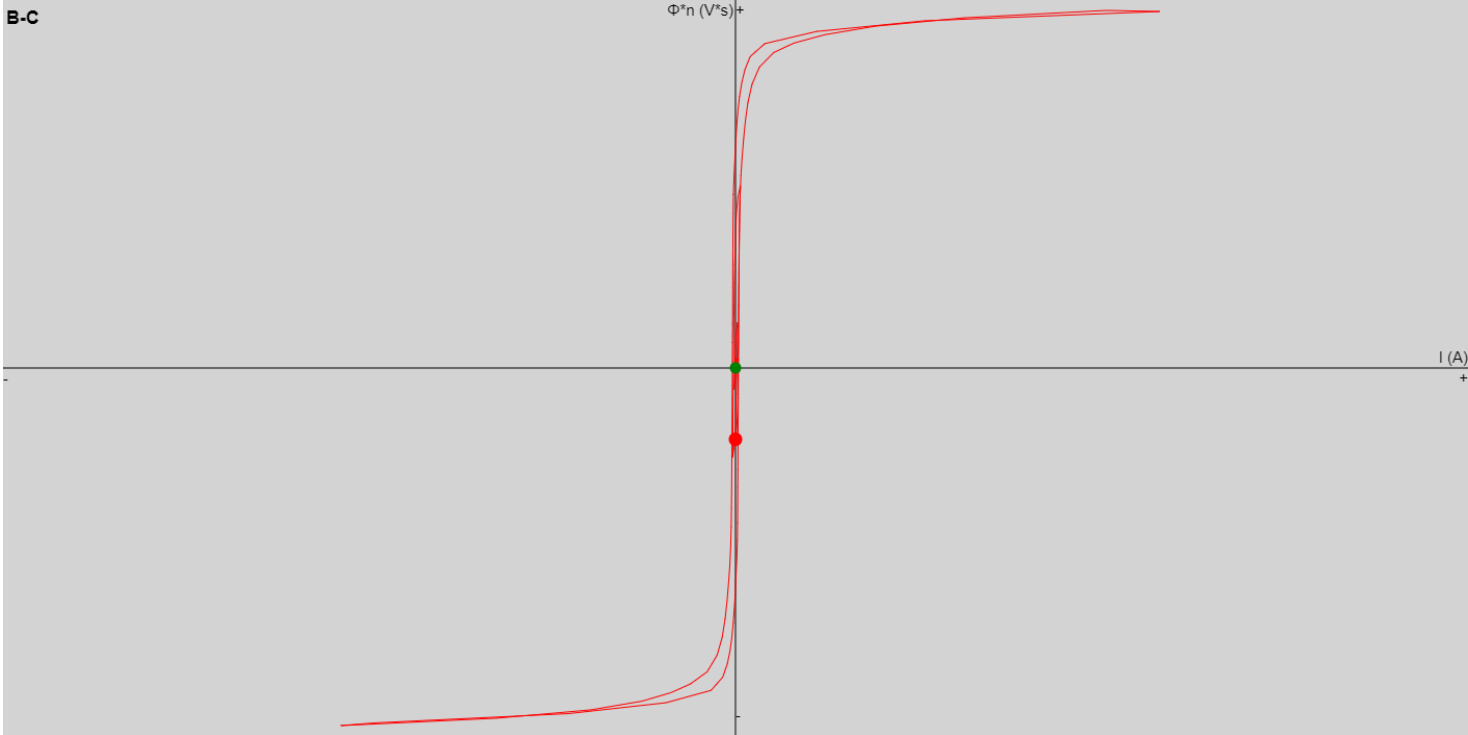
Comment:





Demag measurements

Designation	Current	Time	Remanence before demag	Remanence after demag
B-C	0.000 A	29.06 s	19.91 %	<1 %



Comment:



LV Winding resistance measurements

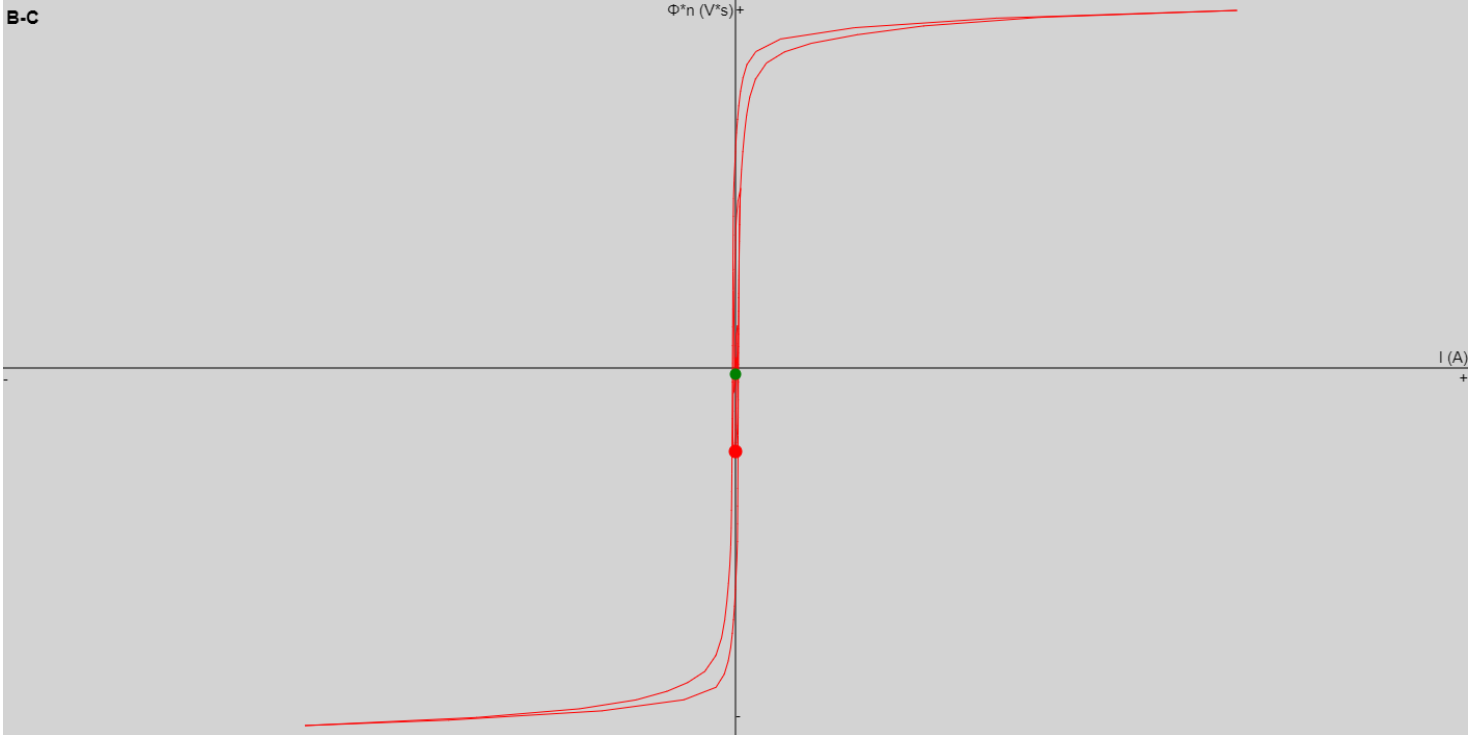
Connection	Tap (S)	Current	40°C Resistance corrected to 75°C	Stability	Variation
a-n	1	9.991 A	14.61 mΩ	99.51 %	---
b-n	1	10.00 A	14.79 mΩ	99.59 %	---
c-n	1	9.999 A	14.94 mΩ	99.89 %	2.25 %

Comment:



Demag measurements

Designation	Current	Time	Remanence before demag	Remanence after demag
B-C	0.000 A	32.00 s	23.18 %	1.586 %



Comment:



TRANSFORMER OLTC DYNAMIC RESISTANCE TEST REPORT

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



On Load Tap Changer Measurements

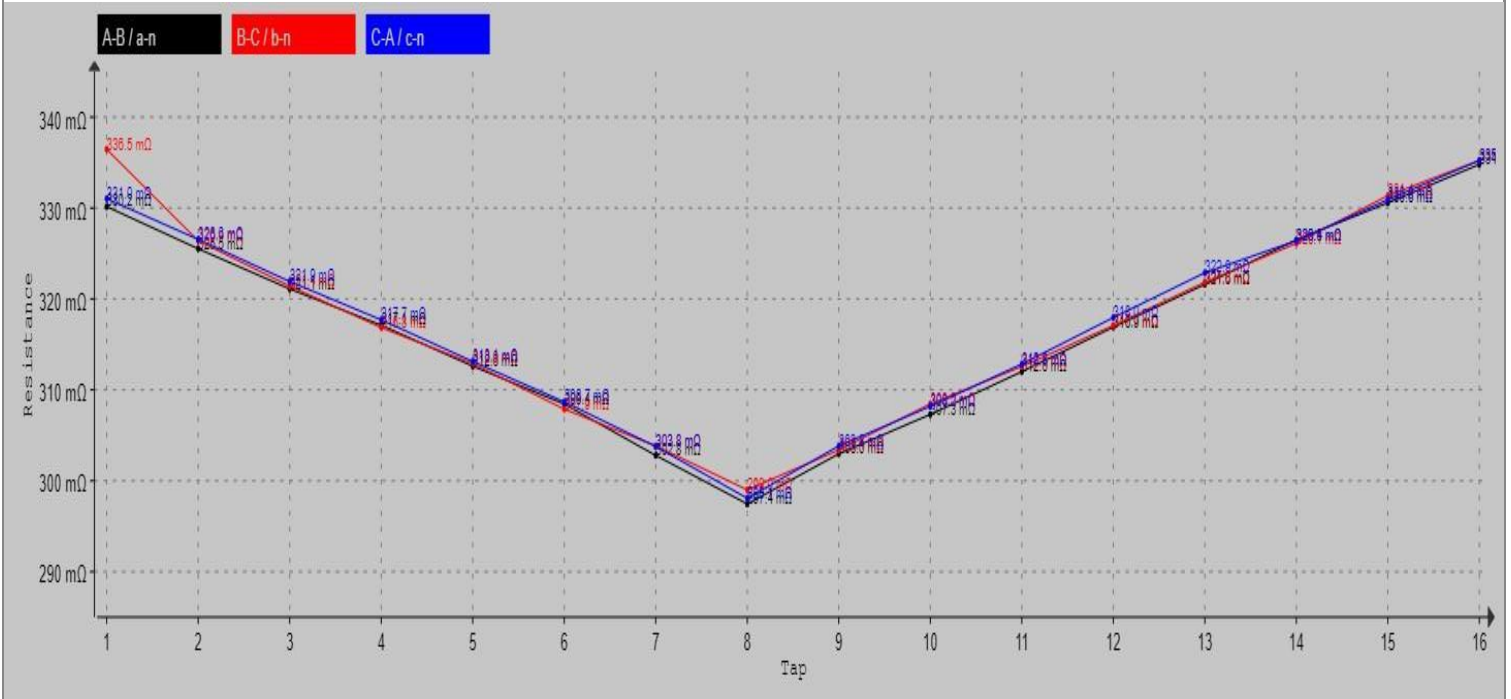
Software configuration

OLTC Type		Taps on		Secondary Side		
Non-vacuum R		Primary		Open Circuit		
Connection	Transition	t start	t	Ripple	Slope	Continuity
A-B / a-n	16 → 15	4.725 s	65.6 ms	11.24 %	8.547 A/s	✓
A-B / a-n	15 → 14	4.45 s	66.7 ms	11.27 %	8.432 A/s	✓
A-B / a-n	14 → 13	4.443 s	65.2 ms	10.89 %	8.349 A/s	✓
A-B / a-n	13 → 12	4.442 s	66.8 ms	10.74 %	8.022 A/s	✓
A-B / a-n	12 → 11	4.428 s	66.7 ms	10.49 %	7.849 A/s	✓
A-B / a-n	11 → 10	4.451 s	66.3 ms	10.31 %	7.760 A/s	✓
A-B / a-n	10 → 9	4.423 s	65.4 ms	10.06 %	7.677 A/s	✓
A-B / a-n	9 → 8	4.432 s	65 ms	9.838 %	7.560 A/s	✓
A-B / a-n	8 → 7	4.424 s	64 ms	8.092 %	6.313 A/s	✓
A-B / a-n	7 → 6	4.428 s	66.7 ms	9.614 %	7.198 A/s	✓
A-B / a-n	6 → 5	4.424 s	64.5 ms	9.339 %	7.234 A/s	✓
A-B / a-n	5 → 4	4.421 s	66.4 ms	9.263 %	6.942 A/s	✓
A-B / a-n	4 → 3	4.43 s	66.8 ms	9.136 %	6.833 A/s	✓
A-B / a-n	3 → 2	4.431 s	65.9 ms	8.962 %	6.781 A/s	✓
A-B / a-n	2 → 1	4.411 s	65.3 ms	8.752 %	6.688 A/s	✓
A-B / a-n	--	---	---	---	---	✓
B-C / b-n	1 → 2	4.683 s	64.4 ms	8.363 %	6.501 A/s	✓
B-C / b-n	2 → 3	4.404 s	62.9 ms	8.217 %	6.522 A/s	✓
B-C / b-n	3 → 4	4.4 s	62.7 ms	8.266 %	6.579 A/s	✓
B-C / b-n	4 → 5	4.4 s	62 ms	8.330 %	6.689 A/s	✓
B-C / b-n	5 → 6	4.39 s	63.6 ms	8.683 %	6.822 A/s	✓
B-C / b-n	6 → 7	4.389 s	62.8 ms	8.682 %	6.900 A/s	✓
B-C / b-n	7 → 8	4.394 s	62.9 ms	8.968 %	7.113 A/s	✓
B-C / b-n	8 → 9	4.394 s	64.6 ms	10.57 %	8.165 A/s	✓
B-C / b-n	9 → 10	4.383 s	63.7 ms	9.177 %	7.192 A/s	✓
B-C / b-n	10 → 11	4.38 s	63.4 ms	9.300 %	7.324 A/s	✓
B-C / b-n	11 → 12	4.382 s	62.4 ms	9.316 %	7.468 A/s	✓
B-C / b-n	12 → 13	4.394 s	62 ms	9.381 %	7.535 A/s	✓
B-C / b-n	13 → 14	4.393 s	63.3 ms	9.800 %	7.727 A/s	✓
B-C / b-n	14 → 15	4.391 s	62.7 ms	9.825 %	7.819 A/s	✓
B-C / b-n	15 → 16	4.383 s	62.9 ms	10.26 %	8.135 A/s	✓
B-C / b-n	--	---	---	---	---	✓
C-A / c-n	16 → 15	4.73 s	64.8 ms	10.67 %	8.218 A/s	✓
C-A / c-n	15 → 14	4.414 s	66.6 ms	10.75 %	8.063 A/s	✓
C-A / c-n	14 → 13	4.418 s	66.7 ms	10.52 %	7.857 A/s	✓
C-A / c-n	13 → 12	4.405 s	66.7 ms	10.33 %	7.739 A/s	✓
C-A / c-n	12 → 11	4.423 s	66.2 ms	10.12 %	7.627 A/s	✓
C-A / c-n	11 → 10	4.417 s	66.4 ms	9.935 %	7.468 A/s	✓
C-A / c-n	10 → 9	4.404 s	66.5 ms	9.762 %	7.321 A/s	✓
C-A / c-n	9 → 8	4.4 s	66.2 ms	9.669 %	7.295 A/s	✓

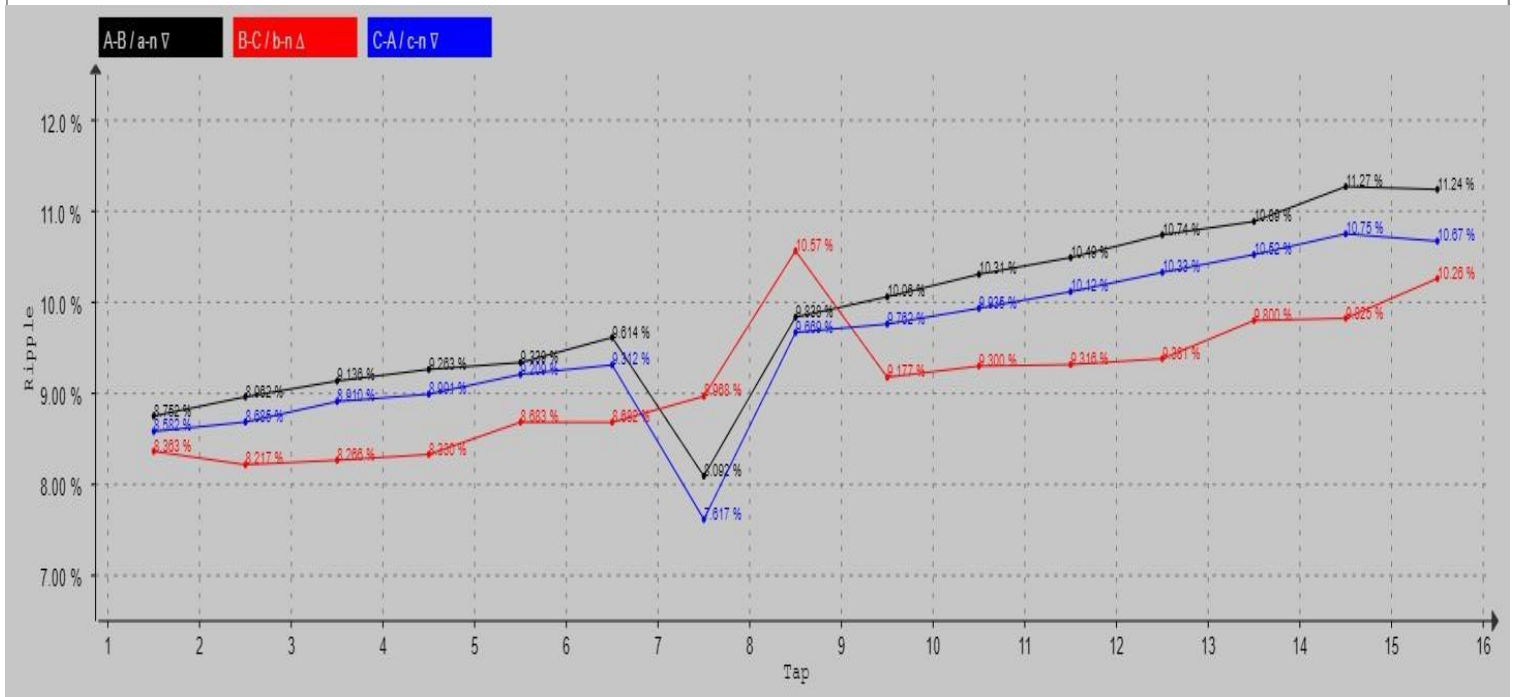
Connection	▲ Transition	t start	t	Ripple	Slope	Continuity
C-A / c-n	8 → 7	4.403 s	62.8 ms	7.617 %	6.057 A/s	✓
C-A / c-n	7 → 6	4.393 s	67.6 ms	9.312 %	6.886 A/s	✓
C-A / c-n	6 → 5	4.415 s	66.6 ms	9.209 %	6.913 A/s	✓
C-A / c-n	5 → 4	4.4 s	66.3 ms	8.991 %	6.774 A/s	✓
C-A / c-n	4 → 3	4.417 s	67.1 ms	8.910 %	6.626 A/s	✓
C-A / c-n	3 → 2	4.418 s	66.3 ms	8.685 %	6.528 A/s	✓
C-A / c-n	2 → 1	4.396 s	65.3 ms	8.582 %	6.584 A/s	✓
C-A / c-n	--	---	---	---	---	✓
40°C Resistance corrected to 75°C						
Connection	▲ Tap (P)	Tap Voltage (V)	Current		Stability	Variation
A-B / a-n	16	28 040	5.001 A	366.7 mΩ	99.78 %	---
A-B / a-n	15	28 591	5.000 A	362.1 mΩ	99.90 %	---
A-B / a-n	14	29 143	5.000 A	357.7 mΩ	99.92 %	---
A-B / a-n	13	29 694	5.000 A	352.3 mΩ	99.90 %	---
A-B / a-n	12	30 245	5.000 A	347.1 mΩ	99.90 %	---
A-B / a-n	11	30 797	5.000 A	341.8 mΩ	99.92 %	---
A-B / a-n	10	31 348	5.000 A	336.6 mΩ	99.95 %	---
A-B / a-n	9	31 899	5.000 A	331.9 mΩ	99.93 %	---
A-B / a-n	8	32 451	5.000 A	325.8 mΩ	100.0 %	---
A-B / a-n	7	33 002	5.000 A	331.7 mΩ	99.97 %	---
A-B / a-n	6	33 553	5.000 A	337.9 mΩ	99.89 %	---
A-B / a-n	5	34 105	5.000 A	342.4 mΩ	99.86 %	---
A-B / a-n	4	34 656	5.000 A	347.4 mΩ	99.90 %	---
A-B / a-n	3	35 207	5.000 A	351.7 mΩ	99.93 %	---
A-B / a-n	2	35 759	5.000 A	356.6 mΩ	99.92 %	---
A-B / a-n	1	36 310	5.000 A	361.7 mΩ	99.92 %	---
B-C / b-n	1	36 310	5.001 A	368.6 mΩ	98.79 %	---
B-C / b-n	2	35 759	5.000 A	357.5 mΩ	99.74 %	---
B-C / b-n	3	35 207	4.999 A	352.1 mΩ	99.57 %	---
B-C / b-n	4	34 656	5.001 A	347.1 mΩ	99.69 %	---
B-C / b-n	5	34 105	5.000 A	342.7 mΩ	99.26 %	---
B-C / b-n	6	33 553	5.000 A	337.3 mΩ	99.74 %	---
B-C / b-n	7	33 002	5.000 A	332.8 mΩ	99.84 %	---
B-C / b-n	8	32 451	5.000 A	327.5 mΩ	99.93 %	---
B-C / b-n	9	31 899	4.999 A	332.3 mΩ	99.93 %	---
B-C / b-n	10	31 348	5.000 A	337.9 mΩ	99.76 %	---
B-C / b-n	11	30 797	5.000 A	342.4 mΩ	99.63 %	---
B-C / b-n	12	30 245	5.001 A	347.3 mΩ	99.91 %	---
B-C / b-n	13	29 694	5.001 A	352.5 mΩ	99.81 %	---

Connection	▲ Tap (P)	Tap Voltage (V)	Current	40°C Resistance corrected to 75°C	Stability	Variation
B-C / b-n	14	29 143	5.000 A	357.2 mΩ	99.77 %	---
B-C / b-n	15	28 591	5.001 A	363.0 mΩ	99.83 %	---
B-C / b-n	16	28 040	5.000 A	367.2 mΩ	99.93 %	---
C-A / c-n	16	28 040	5.000 A	367.2 mΩ	99.77 %	0.13 %
C-A / c-n	15	28 591	5.000 A	362.5 mΩ	99.85 %	0.24 %
C-A / c-n	14	29 143	5.000 A	357.5 mΩ	99.93 %	0.12 %
C-A / c-n	13	29 694	5.000 A	353.7 mΩ	99.94 %	0.40 %
C-A / c-n	12	30 245	5.000 A	348.3 mΩ	99.95 %	0.33 %
C-A / c-n	11	30 797	5.000 A	342.7 mΩ	99.96 %	0.27 %
C-A / c-n	10	31 348	5.000 A	337.6 mΩ	99.94 %	0.38 %
C-A / c-n	9	31 899	5.000 A	332.8 mΩ	99.94 %	0.29 %
C-A / c-n	8	32 451	5.000 A	326.5 mΩ	100.0 %	0.52 %
C-A / c-n	7	33 002	5.000 A	332.7 mΩ	99.98 %	0.34 %
C-A / c-n	6	33 553	5.000 A	338.1 mΩ	99.94 %	0.26 %
C-A / c-n	5	34 105	5.000 A	343.0 mΩ	99.96 %	0.16 %
C-A / c-n	4	34 656	5.000 A	348.0 mΩ	99.99 %	0.27 %
C-A / c-n	3	35 207	5.000 A	352.6 mΩ	99.96 %	0.25 %
C-A / c-n	2	35 759	5.000 A	357.7 mΩ	99.93 %	0.32 %
C-A / c-n	1	36 310	5.000 A	362.6 mΩ	99.96 %	1.90 %

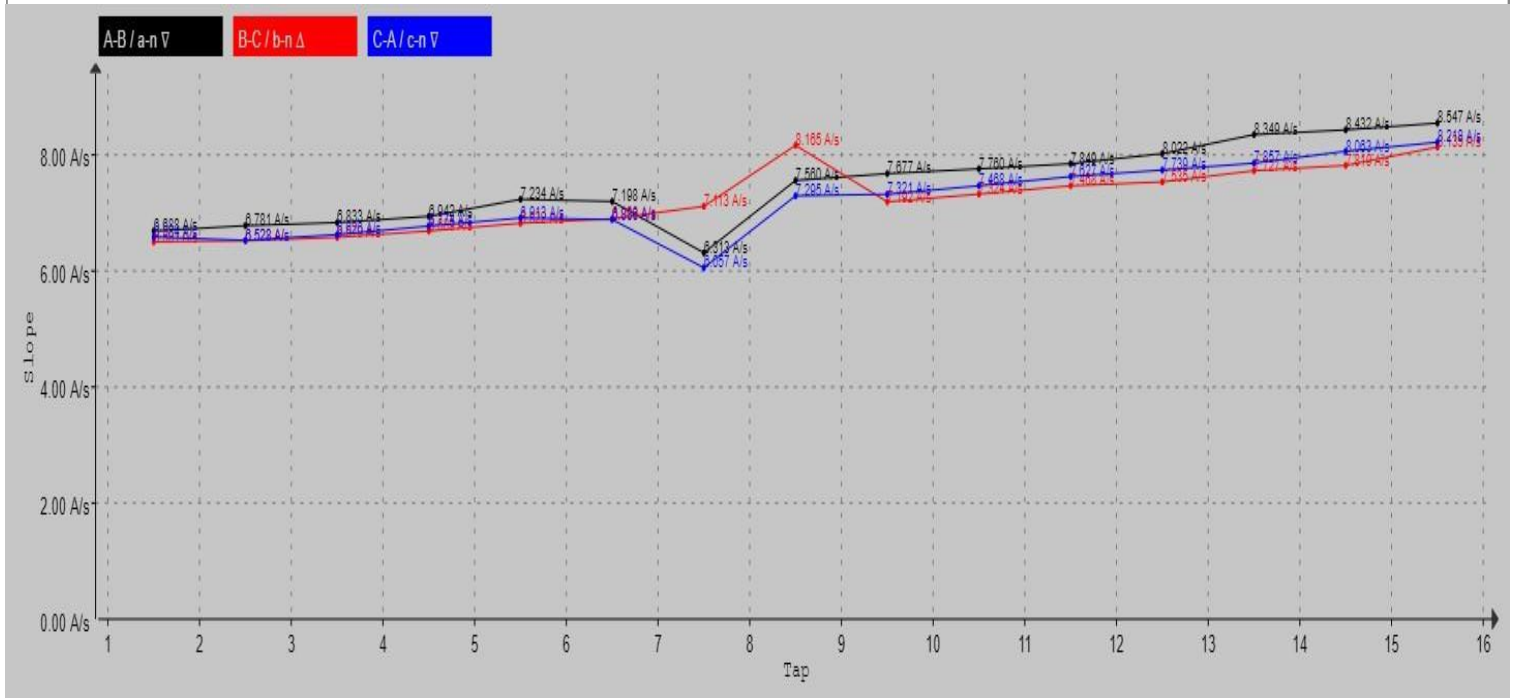
WRM



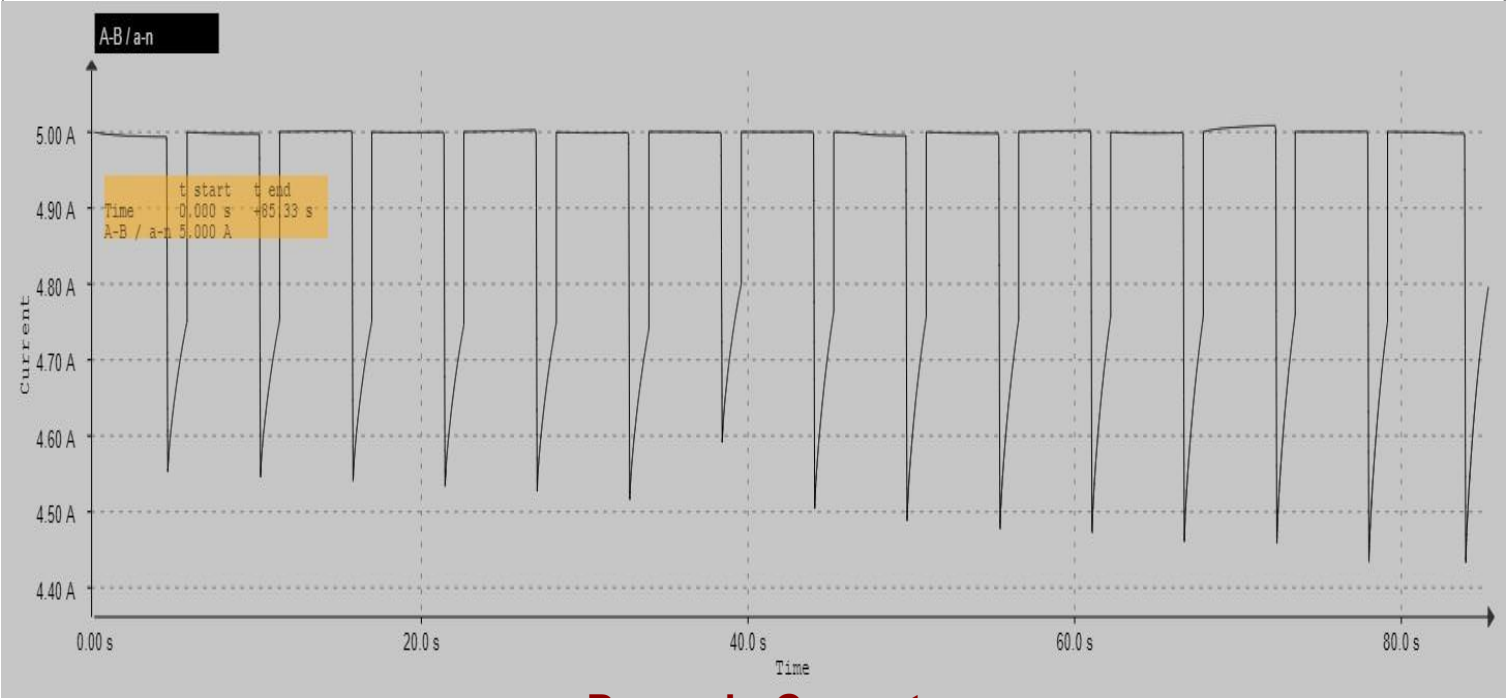
Ripple



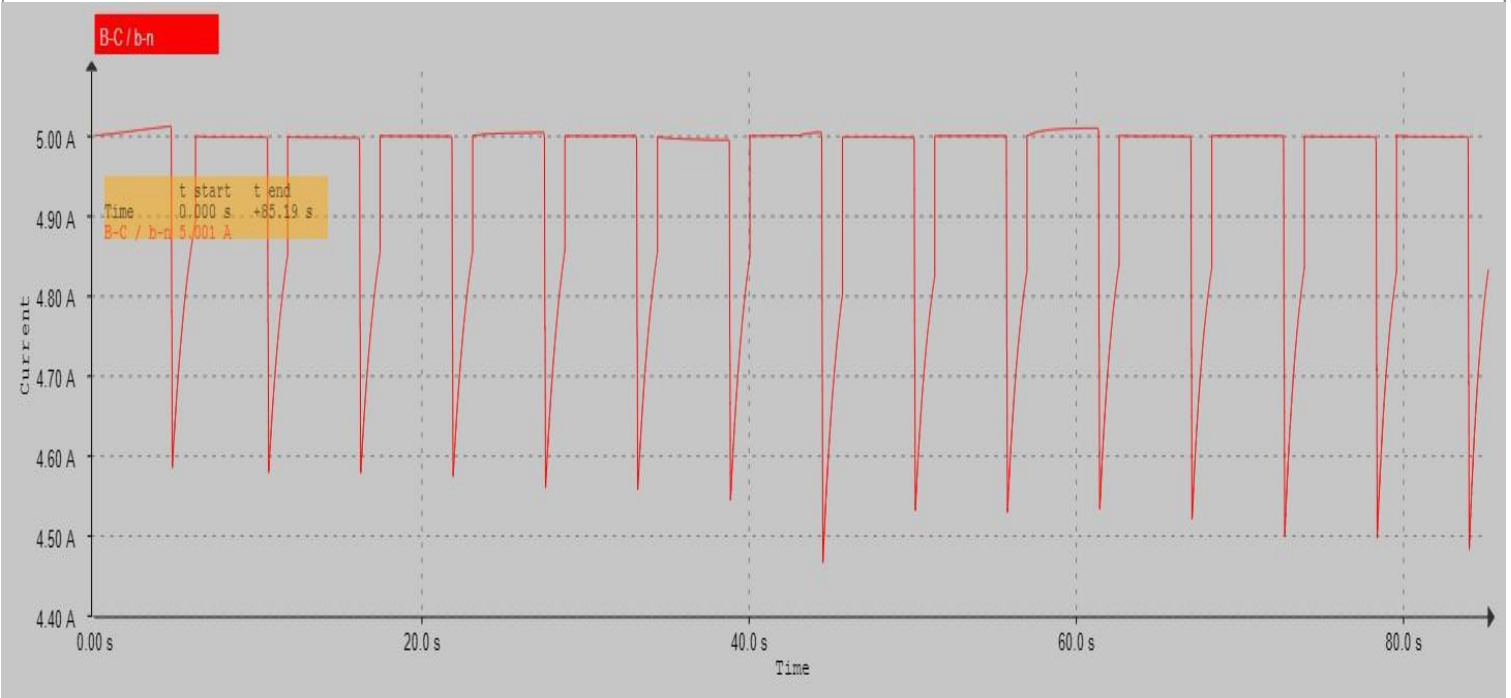
Slope



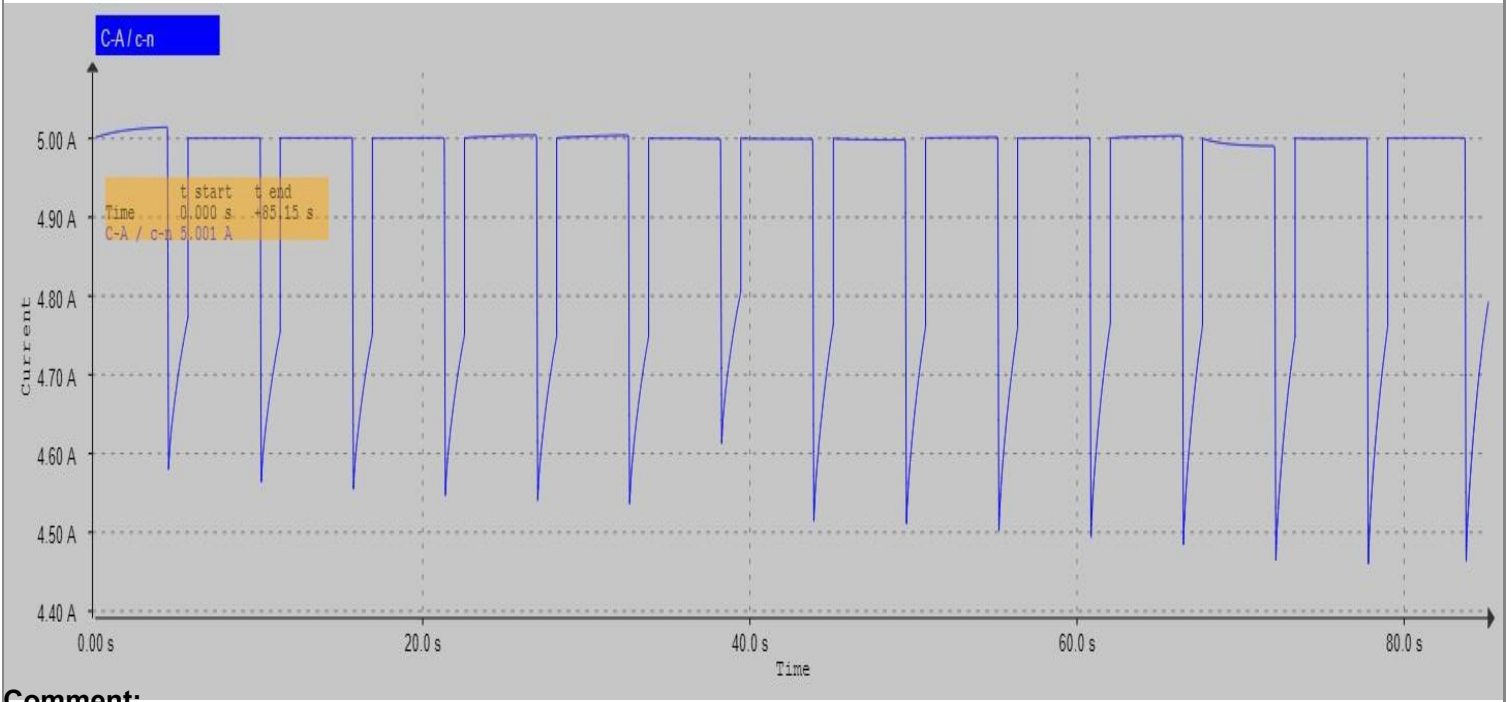
Dynamic Current



Dynamic Current



Dynamic Current

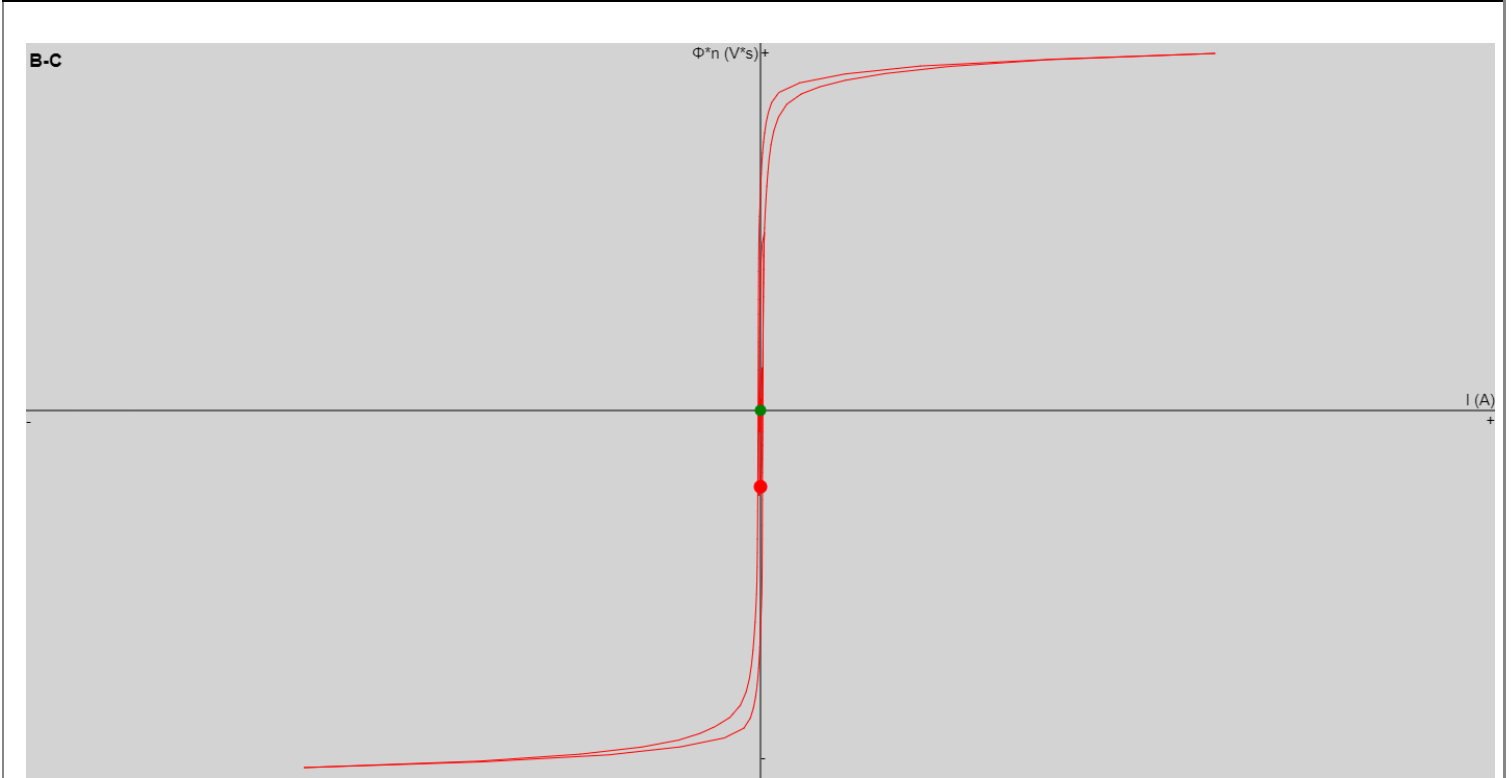


Comment:



Demag measurements

Designation	Current	Time	Remanence before demag	Remanence after demag
B-C	0.000 A	35.49 s	21.36 %	<1 %



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 : PPU PENGKALAN HULU	Manufacture year: 2008
Circuit : 33/11KV MTM TRANSFORMER :2	Serial No.: P/320/07/15010
BAY ID: TX2	

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 : 1460 MΩ

HVTo E: 1850 MΩ

1.267123

LV To E : 1020 MΩ

LV To E : 1260 MΩ

1.235294

HVToLV: 1120 MΩ

HVToLV: 1420 MΩ

1.267857

NOTE: AMBIENT TEMPERATURE: 36 °C

OIL TEMPERATURE: 36 °C

TIME : 10.50 AM

Tested by:	Witnessed by:	Verified by :	ESE COMMENT:
Name: VICKNESH Dept: Tester	Name: Mr. ARIF Dept: TNB	Name: Dept:	
Date: 04/08/2024	Date: 04/08/2024	Date: 04/08/2024	



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

RECOGNIZED AND CERTIFIED USER OF **Megger**



TRANSFORMER CT RATIO, POLARITY & SATURATION

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

TEST REPORT

TRAX - Test report

Test Asset

Substation	PPU PENGKALAN HULU
Position	PERAK
Job	AFTER SERVICE
Transformer	TX2

Test Conditions

Reason	MAJOR	°C ▼ %
Weather	SUNNY	
Ambient Temperature	34	
Humidity	65.00	
Date	04/08/2024	
Tester	VICKNESH	

Current Transformer Information

Number of CTs	2
---------------	---

CT1

Manufacturer	MTM	Year	2008
Serial	P/320/07/15010	Number of cores	1
Type	15-201	Standard	IEC76
Frequency	50	Primary voltage (kV)	0
Notes			

Core 1

Label	CT1-HV	Taps	2	Type	Meter
In service tap	1S1	FS Alf	0	Accuracy class	3
Primary nominal current	309	Secondary nominal current	1.5	CT VA rating	15VA
Notes					
Compensated ALF/FS	Calculated at:		FS-C		

Insulation resistance result

Primary to secondary		Primary to ground		Secondary to ground	
Reading	Testvoltage (kV)	Reading	Testvoltage (kV)	Reading	Testvoltage (kV)
	MOhm		MOhm		MOhm

CT2

Manufacturer	MTM	Year	2008
Serial	P/320/07/15010	Number of cores	1
Type	15-201	Standard	IEC76
Frequency	50	Primary voltage (kV)	0
Notes			

Core 1

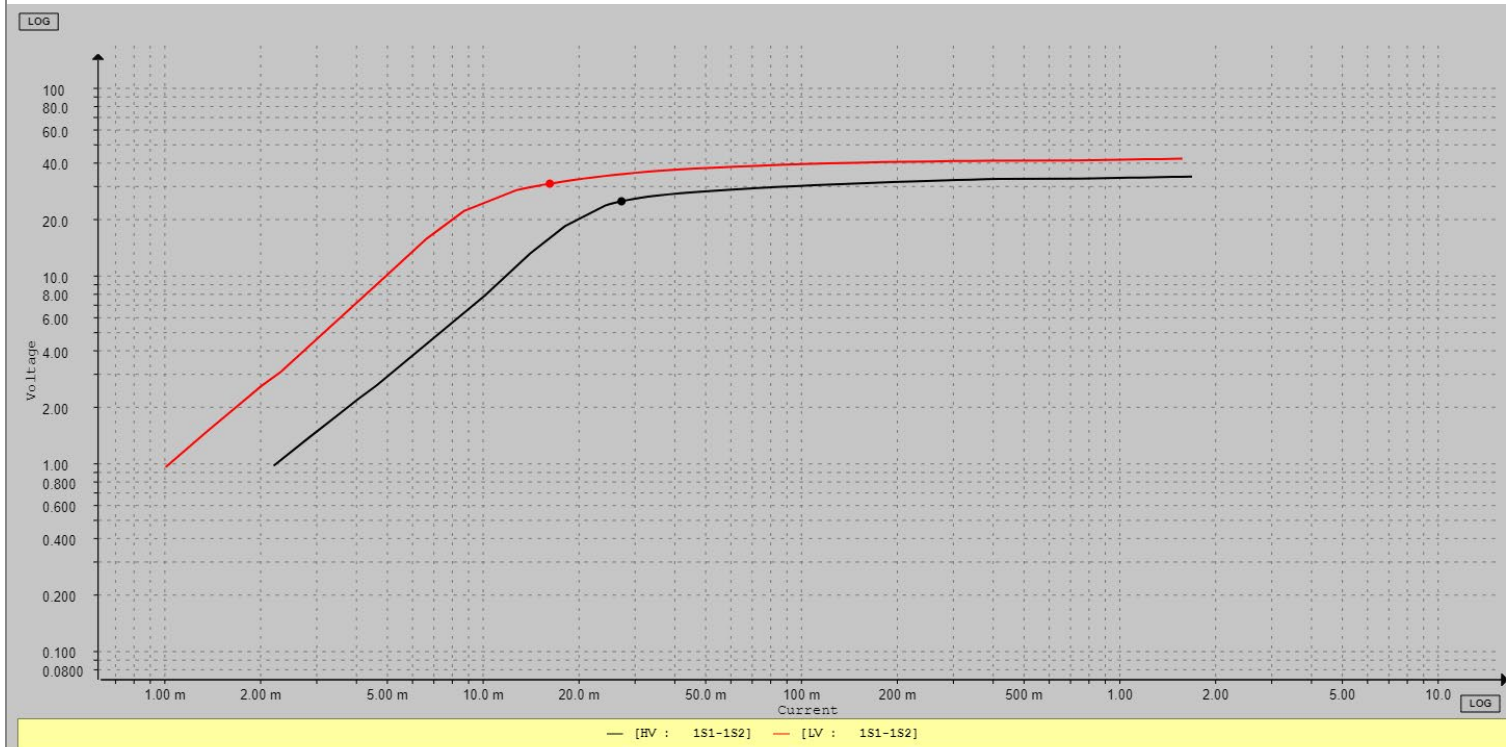
Label	CT2-LV	Taps	2	Type	Meter
-------	--------	------	---	------	-------

In service tap	1S1		FS Alf	0	Accuracy class	3																										
Primary nominal current	787		Secondary nominal current	1.5	CT VA rating	15VA																										
Notes																																
Compensated ALF/FS	Calculated at:			FS-C																												
Insulation resistance result																																
Primary to secondary			Primary to ground			Secondary to ground																										
Reading		Testvoltage (kV)	Reading		Testvoltage (kV)	Reading		Testvoltage (kV)																								
	MOhm			MOhm			MOhm																									
Comment:																																
Test results																																
CT ratio U measurements <table><thead><tr><th>Designation</th><th>U</th><th>Ratio</th><th>Measured ratio</th><th>Ratio Error</th><th>Phase Error</th><th>Polarity</th><th>Current</th></tr></thead><tbody><tr><td>HV : 1S1-1S2/P1-P2</td><td>4.999 V</td><td>309.0 : 1.500 (206.0)</td><td>204.4</td><td>0.79 %</td><td>-0.01 °</td><td>Pass</td><td>8.342 mA</td></tr><tr><td>LV : 1S1-1S2/P1-P2</td><td>4.989 V</td><td>787.0 : 1.500 (524.7)</td><td>520.7</td><td>0.76 %</td><td>0.03 °</td><td>Pass</td><td>3.395 mA</td></tr></tbody></table>									Designation	U	Ratio	Measured ratio	Ratio Error	Phase Error	Polarity	Current	HV : 1S1-1S2/P1-P2	4.999 V	309.0 : 1.500 (206.0)	204.4	0.79 %	-0.01 °	Pass	8.342 mA	LV : 1S1-1S2/P1-P2	4.989 V	787.0 : 1.500 (524.7)	520.7	0.76 %	0.03 °	Pass	3.395 mA
Designation	U	Ratio	Measured ratio	Ratio Error	Phase Error	Polarity	Current																									
HV : 1S1-1S2/P1-P2	4.999 V	309.0 : 1.500 (206.0)	204.4	0.79 %	-0.01 °	Pass	8.342 mA																									
LV : 1S1-1S2/P1-P2	4.989 V	787.0 : 1.500 (524.7)	520.7	0.76 %	0.03 °	Pass	3.395 mA																									
Comment:																																



CT Saturation measurements

Designation	Test frequency	Iknee	Uknee
HV : 1S1-1S2	50.00 Hz	27.20 mA	25.03 V
LV : 1S1-1S2	50.00 Hz	16.19 mA	31.08 V



Comment:

CT1		CT2	
Core1		Core1	
HV : 1S1-1S2		LV : 1S1-1S2	
Current	Voltage	Current	Voltage
2.197 mA	977.6 mV	1.006 mA	961.7 mV
2.839 mA	1.381 V	1.360 mA	1.493 V
3.505 mA	1.824 V	1.704 mA	2.055 V
4.024 mA	2.197 V	2.011 mA	2.598 V
4.629 mA	2.619 V	2.315 mA	3.092 V
10.15 mA	7.903 V	4.780 mA	9.491 V
14.03 mA	13.17 V	6.645 mA	15.83 V
18.06 mA	18.44 V	8.696 mA	22.19 V
24.15 mA	23.75 V	12.69 mA	28.68 V
24.93 mA	24.15 V	13.29 mA	29.18 V
25.86 mA	24.53 V	13.92 mA	29.66 V
26.86 mA	24.92 V	14.63 mA	30.16 V
28.07 mA	25.31 V	15.42 mA	30.65 V
29.40 mA	25.70 V	16.30 mA	31.14 V
31.03 mA	26.09 V	17.25 mA	31.64 V
32.96 mA	26.48 V	18.30 mA	32.12 V
35.26 mA	26.86 V	19.49 mA	32.62 V
38.12 mA	27.24 V	20.79 mA	33.10 V
41.69 mA	27.63 V	22.25 mA	33.60 V
45.87 mA	28.00 V	23.82 mA	34.07 V
51.11 mA	28.38 V	25.64 mA	34.55 V
57.15 mA	28.74 V	27.75 mA	35.04 V
64.48 mA	29.11 V	30.13 mA	35.51 V
72.95 mA	29.46 V	32.98 mA	35.98 V
83.15 mA	29.81 V	36.46 mA	36.45 V
95.18 mA	30.15 V	40.83 mA	36.91 V

109.8 mA	30.48 V	46.28 mA	37.37 V
126.6 mA	30.80 V	53.12 mA	37.82 V
145.9 mA	31.10 V	61.58 mA	38.26 V
168.2 mA	31.39 V	71.87 mA	38.70 V
192.6 mA	31.66 V	84.74 mA	39.12 V
218.9 mA	31.90 V	100.5 mA	39.51 V
247.5 mA	32.12 V	121.8 mA	39.88 V
277.0 mA	32.32 V	148.9 mA	40.21 V
308.5 mA	32.49 V	181.3 mA	40.48 V
341.4 mA	32.65 V	217.9 mA	40.69 V
377.4 mA	32.79 V	257.7 mA	40.86 V
416.6 mA	32.92 V	299.6 mA	41.00 V
751.8 mA	33.07 V	343.7 mA	41.12 V
826.3 mA	33.18 V	390.0 mA	41.24 V
904.2 mA	33.27 V	730.0 mA	41.38 V
987.2 mA	33.36 V	820.2 mA	41.49 V
1.074 A	33.44 V	914.4 mA	41.60 V
1.164 A	33.52 V	1.014 A	41.71 V
1.259 A	33.60 V	1.114 A	41.82 V
1.356 A	33.68 V	1.221 A	41.93 V
1.458 A	33.76 V	1.330 A	42.05 V
1.564 A	33.83 V	1.446 A	42.17 V
1.686 A	33.93 V	1.573 A	42.30 V



TRANSFORMER AVR CALIBRATION 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	BAY ID: TX2
Station : PPU PENGKALAN HULU	Manufacture year: 2008	
Circuit : 33/11KV MTM TRANSFORMER :2	Serial No.: P/320/07/15010	

AUTOMATIC VOLTAGE REGULATING RELAY TEST CERTIFICATE I

Voltage Regulating Relay:

Make : MR	Type : TAPCON 230
Frequency : 50 HZ	Rated AC Voltage : 110V

1. OPERATING TIME TEST:

Setting (sec)	Time Measured(sec)
60	60↑ 61↓

Remarks: 1. ↑ TAP RAISE OPERATION 2. ↓ TAP LOWER OPERATION

2. UNDER VOLTAGE CHECK BLOCK :

Setting (%KV)	Pick - Up Voltage(KV)	Drop-off Voltage(KV)
85%	9.18	9.23

3. OVER VOLTAGE CHECK BY PASS SET TIME :

Setting (%KV)	Pick - Up Voltage(KV)	Drop-off Voltage(KV)
110%	11.87	11.82

4. OPERATING VOLTAGE AT SET LEVEL :

VOLTAGE	BANDWIDTH - 1.5		BANDWIDTH - 2		BANDWIDTH - 3	
SETTING	RAISE	LOWER	RAISE	LOWER	RAISE	LOWER
10.8 KV	-	-	10.58	11.02	-	-

BANDWIDTH	:1.5 %	TIME	: 60 Sec
UNDER VOLTAGE	:85%	VOLTAGE LEVEL	10.8KV
OVER VOLTAGE	:110%		

Comments: 1. AVR Bandwidth operation setting quite high. Recommend to change Bandwidth setting.

Tested by:	Witnessed by TNB:	Verified by ESE :	ESE COMMENT:
Name: VICKNESH Dept: TESTER	Name: Mr. ARIF Dept: TNB		
Date: 04/08/2024	Date: 04/08/2024	Date: 04/08/2024	



TRANSFORMER OTI,WTI CALIBRATION TEST REPORT

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



SPAJ Electrical
Engineering (M) Sdn. Bhd.

TEST CERTIFICATE
POWER TRANSFORMER TEST

Megger

Client : TENAGA NASIONAL BERHAD	Main Contractor : MALAYSIA TRANSFORMER MANUFACTURING SDN BHD	TX2
Station : PPU PENGKALAN HULU	Manufacture year: 2008	
Circuit : 33/11KV MTM TRANSFORMER-2	Serial No.: P/320/07/15010	

WINDING TEMPERATURE & OIL TEMPERATURE CALIBRATION CERTIFICATE

W/T HV Serial No.	:1441469-16
W/T LV Serial No.	:1441469-30
Oil Temp Serial No.	:1481342-04

A. Calibration Of Temperature Indicator

OIL TEMP	TEMPERATURE INDICATORS (°C)		
(°C)	WTI HV	WTI LV	OIL
130	130	130	130
120	120	120	120
110	110	110	110
100	100	100	100
90	90	90	90
80	80	80	80
70	70	70	70
60	60	60	60
50	50	50	50
40	40	40	40
Ambient(°C)	40	40	40

Calibration of Secondary Amps. Injection:

Duration	W/T (HV)	W/T (LV)
Min.	(°C)	(°C)
0	34	34
10	37	39
20	41	42
30	44	45
45	48	49

HV- 1.27 A LV – 1.5A
Element 0.86 A Element -0.86 A

Make: (AKM)-KIHLSSTROMS

Remarks :

B. Temperature Indicators Settings

Temperature Indicator		Setting	PICK UP	DROP OFF
Winding Temp Hv	Fan	60	60	48
Winding Temp Hv	Alarm	95	95	85
Winding Temp Hv	Trip	105	105	100
Winding Temp Lv	Fan	60	60	48
Winding Temp Lv	Alarm	95	95	85
Winding Temp Lv	Trip	105	105	100
Oil Temp	Alarm	85	84	76
Oil Temp	Trip	95	94	85

Remarks :

Tested by:	Witnessed by TNB:	Verified by ESE :	ESE COMMENT:
Name: VICKNESH Dept: TESTER	Name: Mr. ARIF Dept: TNB		
Date: 04/08/2024	Date: 04/08/2024	Date: 04/08/2024	

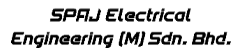


**SPAJ Electrical
Engineering (M) Sdn. Bhd.**

RECOGNIZED AND CERTIFIED USER OF **Megger**



TRANSFORMER GUARD TEST REPORT
***SPAJ Electrical
Engineering (M) Sdn. Bhd.***



Megger

Client :	TENAGA NASIONAL BERHAD	Main Contractor :	MALAYSIA TRANSFORMER MANUFACTURING SDN BHD
Station :	PPU PENGKALAN HULU	Manufacture year:	2008
Circuit :	33/11KV MTM TRANSFORMER-2	Serial No.:	P/320/07/15010
			TX2

Serial No.	Core No.	A - Connection M/ Box			B - Connection 33 kV Relay XTK	Remarks
		Terminal	2J	Apparatus		
1				Buchholz Alarm		OK
2				Buchholz Trip		OK
3				OLTC OSR Trip		OK
4				PRD Trip		OK
5				TR LOW OIL LEVEL		OK
6				OLTC LOW OIL LEVEL		OK
7				OTI Alarm		OK
8				OTI Trip		OK
9				HV WTI Alarm		OK
10				HV WTI Trip		OK
11				LV WTI Alarm		OK
12				LV WTI Trip		OK
				COMMON	COMMON	

COMMON LOOP	(1)	XK-
	(2)	OTA, OLTC & TX MAINTANK OIL LEVEL
	(3)	WTA HV & LV
	(4)	WTT HV & LV
	(5)	BT, OLTC BT & PRD

Tested by:	Witnessed by TNB:	Verified by ESE :	ESE COMMENT:
Name: VICKNESH Dept: TESTER	Name: Mr. ARIF Dept: TNB		
Date: 04/08/2024	Date: 04/08/2024	Date: 04/08/2024	