

# RESUME EXPORT REPORT

Generated: 2026-01-10 17:20:17

## 1. Dataset Summary

Item	Value
Device	Unknown Device
Date Range	28/12/2025 - 03/01/2026
Total Rows	1,689
Start Time	28-12-2025 23:52:35
End Time	03-01-2026 20:42:40
Median Interval	300 seconds (5.0 min)

## 2. First 10 Rows

Timestamp	V (V)	A (A)	W (W)	kWh	Hz	PF
28-12-2025 23:52:35	229.70	0.097	20.80	4.9040	49.9	0.930
28-12-2025 23:57:35	228.70	0.098	20.70	4.9060	49.9	0.920
29-12-2025 00:02:35	228.20	0.096	20.50	4.9070	50.0	0.940
29-12-2025 00:07:35	226.50	0.097	20.50	4.9090	49.9	0.930
29-12-2025 00:12:35	229.30	0.083	18.40	4.9110	50.0	0.970
29-12-2025 00:17:35	227.50	0.084	18.40	4.9120	50.0	0.960
29-12-2025 00:22:35	226.60	0.084	18.40	4.9140	50.0	0.970
29-12-2025 00:27:35	227.30	0.082	18.00	4.9150	50.0	0.970
29-12-2025 00:32:35	227.90	0.020	4.20	4.9160	49.9	0.920
29-12-2025 00:37:35	227.70	0.095	20.80	4.9170	50.0	0.960

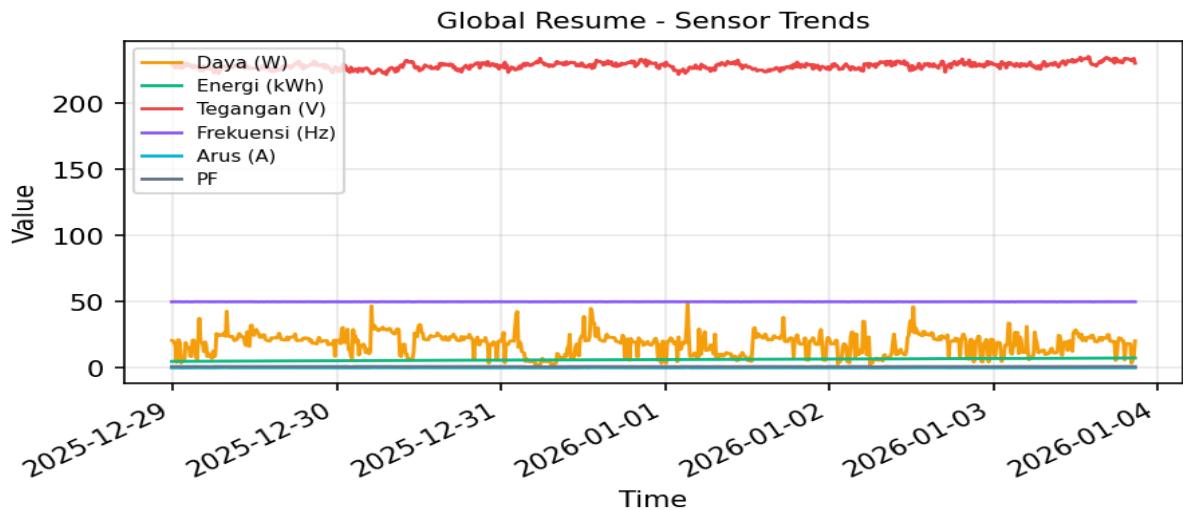
## 3. Last 10 Rows

Timestamp	V (V)	A (A)	W (W)	kWh	Hz	PF
03-01-2026 19:57:40	231.30	0.081	18.00	7.4540	50.0	0.960
03-01-2026 20:02:40	233.00	0.080	18.20	7.4560	50.0	0.980
03-01-2026 20:07:40	231.80	0.081	18.00	7.4570	50.0	0.960
03-01-2026 20:12:40	231.90	0.000	3.60	7.4590	50.1	1.000
03-01-2026 20:17:40	234.30	0.026	6.30	7.4590	50.0	1.000
03-01-2026 20:22:40	233.10	0.025	6.10	7.4600	50.0	1.000
03-01-2026 20:27:40	234.10	0.025	6.10	7.4600	50.0	1.000
03-01-2026 20:32:40	233.90	0.043	8.40	7.4610	50.0	0.840
03-01-2026 20:37:40	233.00	0.094	20.10	7.4620	50.0	0.920

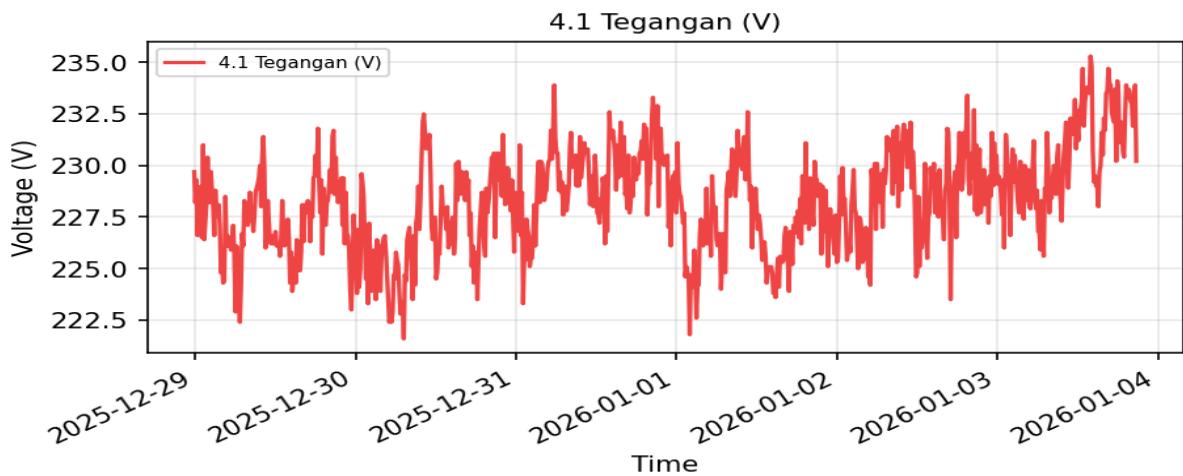
03-01-2026 20:42:40	230.20	0.095	20.40	7.4630	50.0	0.930
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## 4. Global Resume

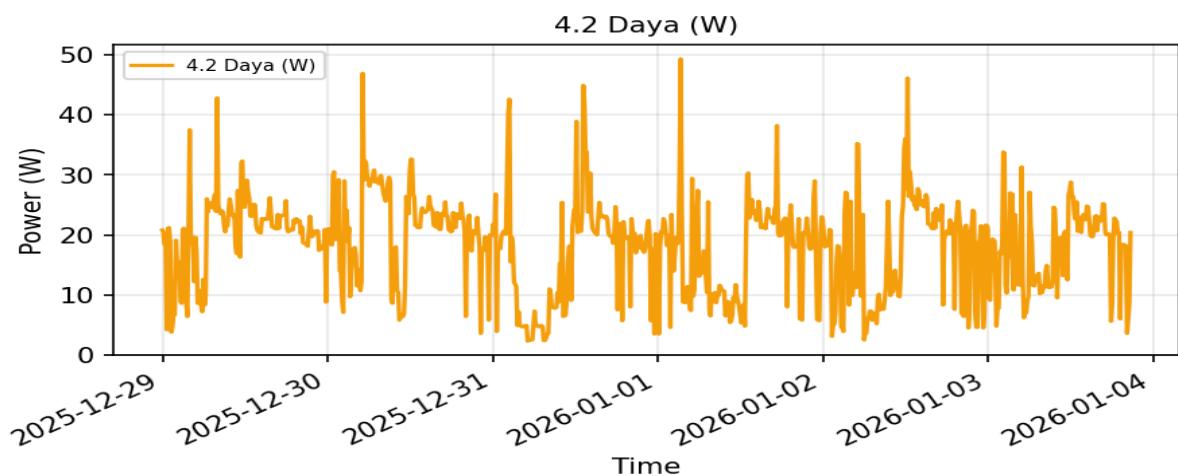
### 4.0 Overall



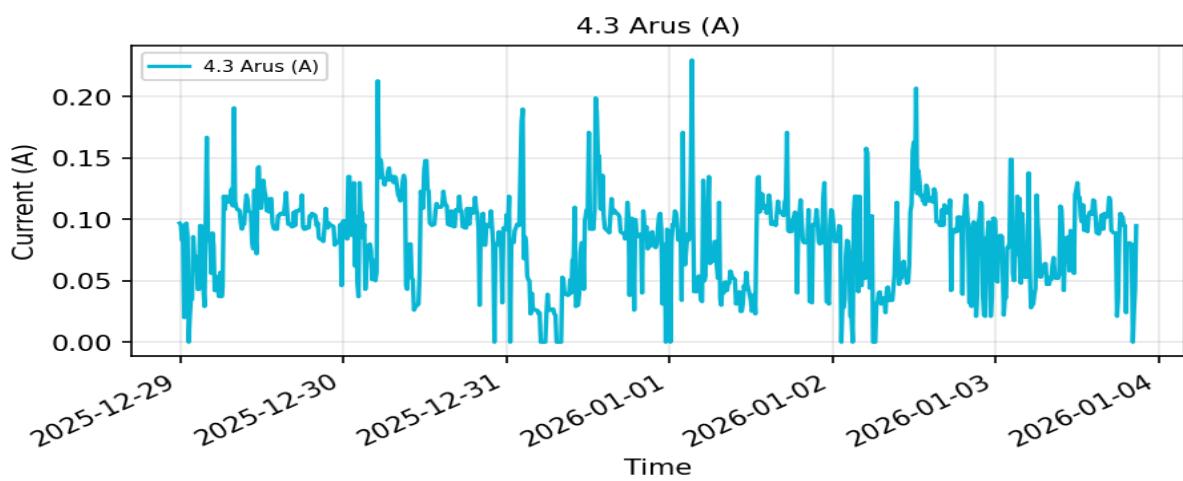
### 4.1 Tegangan (V)



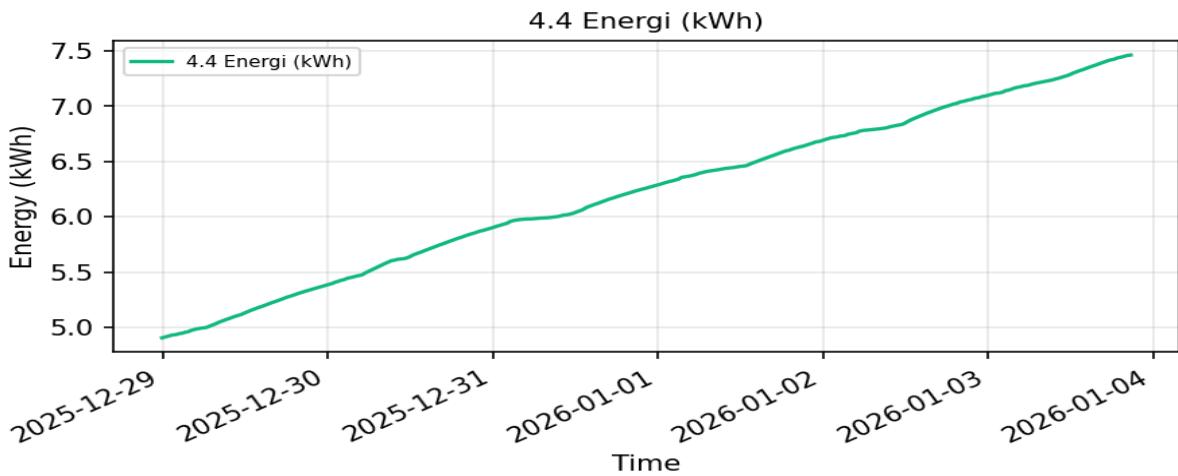
### 4.2 Daya (W)



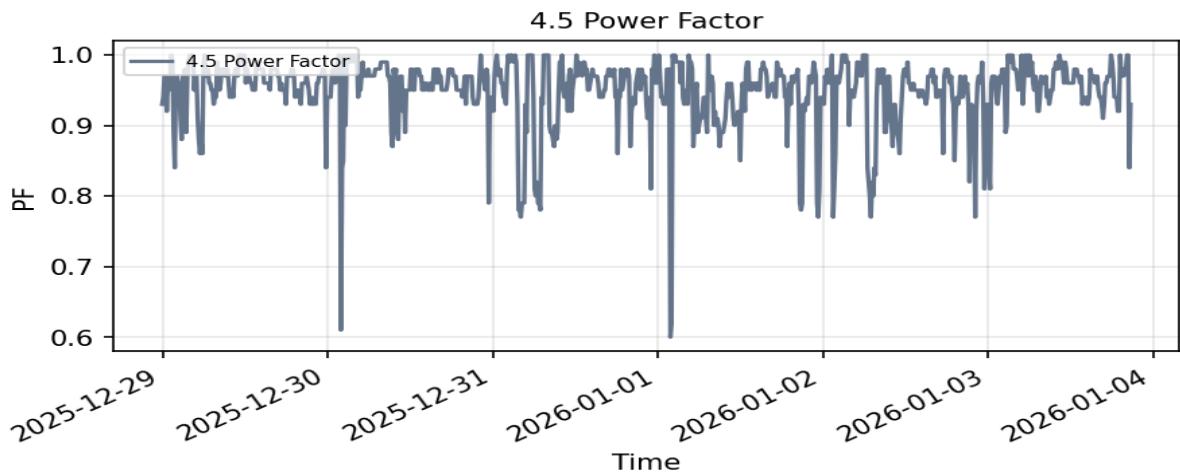
#### 4.3 Arus (A)



#### 4.4 Energi (kWh)



#### 4.5 Power Factor



#### 4.6 Highest Current Points (Arus)

Rank	Timestamp	A (A)	W (W)	V (V)	Hz	kWh	PF
1	01-01-2026 03:17:38	0.230	49.30	224.20	50.0	6.3520	0.960
2	30-12-2025 05:07:37	0.215	47.40	221.90	50.0	5.4810	0.990
3	30-12-2025 05:02:36	0.213	46.90	222.40	50.0	5.4770	0.990
4	30-12-2025 06:57:37	0.212	47.00	223.00	50.0	5.5380	0.990
5	02-01-2026 12:12:39	0.210	46.90	225.70	50.0	6.8580	0.990

#### 4.7 Lowest Current Points (Arus)

Rank	Timestamp	A (A)	W (W)	V (V)	Hz	kWh	PF
1	31-12-2025 04:57:37	0.000	2.40	229.50	50.0	5.9790	1.000
2	02-01-2026 01:17:39	0.000	3.10	227.10	50.0	6.7160	1.000
3	31-12-2025 07:22:37	0.000	2.40	229.00	50.0	5.9890	1.000
4	30-12-2025 22:12:37	0.000	3.60	229.20	50.0	5.8710	1.000
5	31-12-2025 00:32:37	0.000	3.90	231.00	50.0	5.9150	1.000

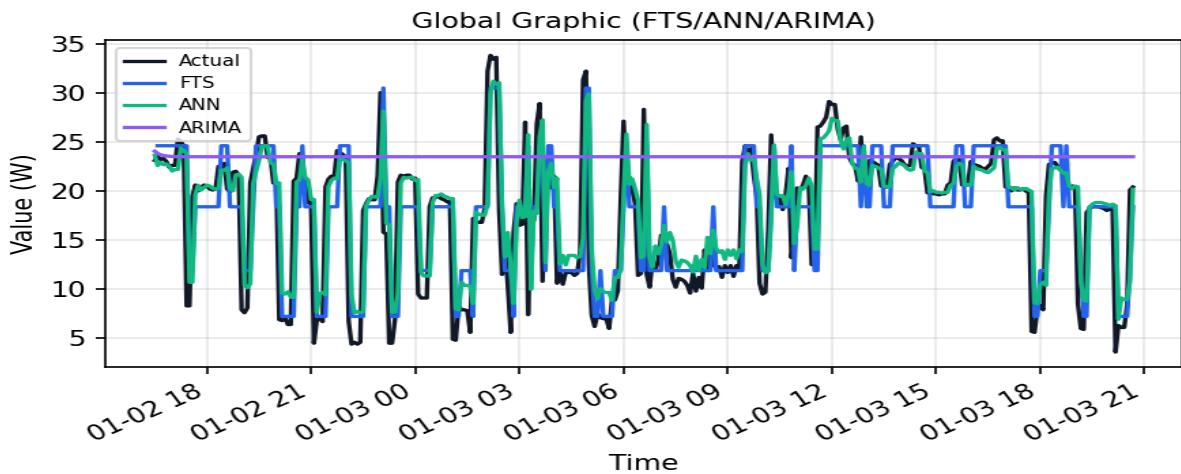
#### 4.8 HOME Average Summary (Rata-rata)

Tanggal Awal	Tanggal Akhir	Jumlah Data	V_avg (V)	A_avg (A)	W_avg (W)	E (kWh)	Hz_avg	PF_avg
28/12/2025	03/01/2026	1,689	228.29	0.083	18.19	2.5590	50.0	0.948

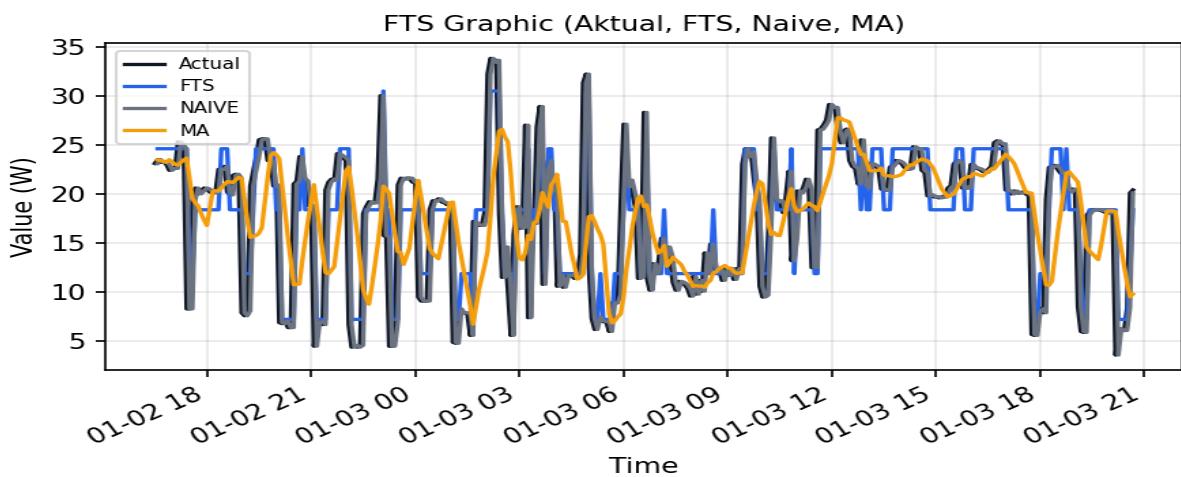
Energy method: **SENSOR\_DELTA**

### 5. Resume Graphic (FTS/ANN/ARIMA)

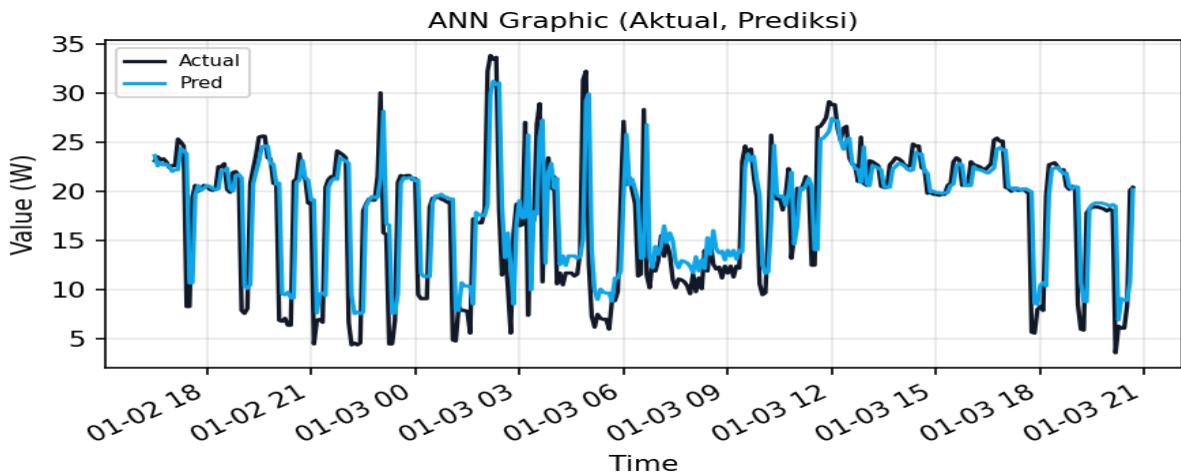
#### 5.0 Global Graphic



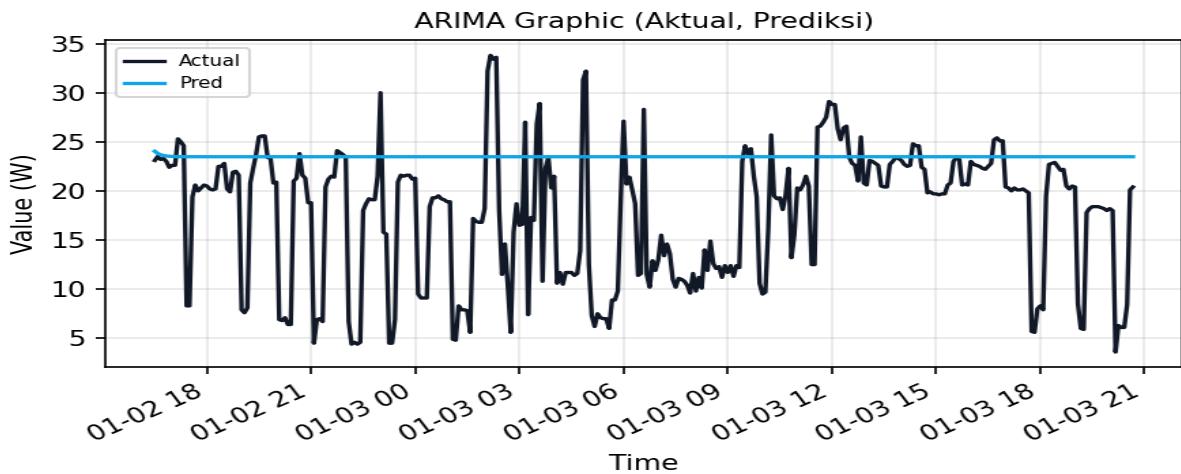
### 5.1 FTS Graphic



### 5.2 ANN Graphic



### 5.3 ARIMA Graphic



## 6. FTS Mathematical Documentation

### 5.1 Universe of Discourse (UoD)

Formula:  $D = [D_{min}, D_{max}]$ ,  $D_{min} = \min(y) - pad$ ,  $D_{max} = \max(y) + pad$ ,  $pad = padPct * (\max(y) - \min(y))$ .

$$D = [D_{min}, D_{max}]$$

$$D_{min} = \min(y) - pad$$

$$D_{max} = \max(y) + pad$$

$$pad = padPct \times (\max(y) - \min(y))$$

Calculation:  $\min(y)=2.3000$ ,  $\max(y)=49.3000$ ,  $span=47.0000$ ,  $padPct=5.0\%$ ,  $D_{min}=-0.0500$ ,  $D_{max}=51.6500$

### 5.2 Partitioning (Equal-Width / Equal-Frequency)

Formula:  $w = (D_{max} - D_{min}) / n$ ;  $A_i = [D_{min} + (i-1)w, D_{min} + iw]$ ,  $A_n = [D_{min} + (n-1)w, D_{max}]$ .

$$w = \frac{D_{max} - D_{min}}{n}$$

$$A_i = [D_{min} + (i - 1)w, D_{min} + iw]$$

$$A_n = [D_{min} + (n - 1)w, D_{max}]$$

$$mid(A_i) = \frac{lo_i + hi_i}{2}$$

Method=Equal Width, n=7, width=7.3857

ID	Lower	Upper	Midpoint
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A1	-0.0500	7.3357	3.6429
A2	7.3357	14.7214	11.0286
A3	14.7214	22.1071	18.4143
A4	22.1071	29.4929	25.8000
A5	29.4929	36.8786	33.1857
A6	36.8786	44.2643	40.5714
A7	44.2643	51.6500	47.9571

### 5.3 Fuzzification

Formula:  $L_t = A_i$  jika  $y_t$  berada pada interval  $[lo_i, hi_i]$ .

$$L_t = A_i, \text{ jika } y_t \in [lo_i, hi_i]$$

Timestamp	W (W)	Label
28-12-2025 23:50:00	20.800	A3
28-12-2025 23:55:00	20.700	A3
29-12-2025 00:00:00	20.500	A3
29-12-2025 00:05:00	20.500	A3
29-12-2025 00:10:00	18.400	A3
29-12-2025 00:15:00	18.400	A3
29-12-2025 00:20:00	18.400	A3
29-12-2025 00:25:00	18.000	A3
29-12-2025 00:30:00	4.200	A1
29-12-2025 00:35:00	20.800	A3

### 5.4 Fuzzy Logical Relationship (FLR)

Formula:  $FLR = \{(L_{t-1}, L_t)\}$  atau  $A_i \rightarrow A_j$ .

$$A_i \rightarrow A_j$$

$$FLR = \{(L_{t-1}, L_t)\}$$

No	Relation
1	$A3 \rightarrow A3$
2	$A3 \rightarrow A3$
3	$A3 \rightarrow A3$
4	$A3 \rightarrow A3$
5	$A3 \rightarrow A3$
6	$A3 \rightarrow A3$

7	A3 -> A3
8	A3 -> A1
9	A1 -> A3
10	A3 -> A3

... 1341 relasi lainnya ...

### 5.5 Fuzzy Logical Relationship Group (FLRG)

Formula:  $A_i \rightarrow \{A_j\}$  dengan support =  $\text{count}(A_i \rightarrow A_j) / \text{total}(A_i)$ .

$$A_i \rightarrow \{A_{j_1}, A_{j_2}, \dots\}$$

$$\text{support}(A_i \rightarrow A_j) = \frac{\text{count}(A_i \rightarrow A_j)}{\sum_j \text{count}(A_i \rightarrow A_j)}$$

Group	Next States (Support)
A1	A1 (70.8%), A3 (15.8%), A2 (11.7%), A4 (1.8%)
A2	A2 (77.2%), A1 (8.6%), A3 (8.2%), A4 (6.0%)
A3	A3 (79.1%), A4 (9.6%), A1 (4.7%), A2 (4.7%), A5 (1.4%), A6 (0.4%)
A4	A4 (78.4%), A3 (13.0%), A5 (3.3%), A2 (2.3%), A1 (1.8%), A7 (0.8%), A6 (0.5%)
A5	A5 (57.1%), A4 (30.6%), A3 (4.1%), A6 (4.1%), A2 (2.0%), A7 (2.0%)
A6	A4 (30.0%), A6 (30.0%), A3 (20.0%), A5 (10.0%), A7 (10.0%)
A7	A4 (57.1%), A7 (28.6%), A6 (14.3%)

### 5.6 Forecasting (Cheng Method)

Formula:  $\hat{y}_{t+1} = \sum(\text{support} * \text{midpoint})$ . Fallback:  $\hat{y}_{\text{hat}} = \text{midpoint}(A_i)$ .

$$\hat{y}_{t+1} = \sum_j \text{support}(L_t \rightarrow A_j) \text{mid}_j$$

$$\hat{y}_{t+1} = \text{mid}(L_t) \quad (\text{fallback})$$

t	Timestamp	Actual (W)	Pred (W)
2	02-01-2026 16:35:00	23.500	24.597
3	02-01-2026 16:40:00	23.200	24.597
4	02-01-2026 16:45:00	23.300	24.597
5	02-01-2026 16:50:00	23.000	24.597
6	02-01-2026 16:55:00	22.400	24.597
7	02-01-2026 17:00:00	22.600	24.597
8	02-01-2026 17:05:00	22.600	24.597
9	02-01-2026 17:10:00	25.300	24.597
10	02-01-2026 17:15:00	25.000	24.597
11	02-01-2026 17:20:00	24.600	24.597

## 5.7 Evaluation Metrics

Formula: MAE =  $\text{mean}(|y - y_{\text{hat}}|)$ , RMSE =  $\sqrt{\text{mean}((y - y_{\text{hat}})^2)}$ , MAPE =  $\text{mean}(|(y - y_{\text{hat}})/y|) * 100$ .

$$MAE = \frac{1}{n} \sum_{t=1}^n |Y_t - \hat{Y}_t|$$

$$RMSE = \sqrt{\frac{1}{n} \sum_{t=1}^n (Y_t - \hat{Y}_t)^2}$$

$$MAPE = \frac{100\%}{n} \sum_{t=1}^n \left| \frac{Y_t - \hat{Y}_t}{Y_t} \right|$$

Metric	Value
MAE	3.2877
RMSE	4.9877
MAPE (%)	26.07

## 5.8 Baseline Models Comparison

Formula: Naive  $y_{\text{hat}}(t+1) = y_t$ , Moving Average  $y_{\text{hat}}(t+1) = \text{mean}(y_{\{t-w+1}\dots y_t})$ .

$$\hat{y}_{t+1} = y_t \quad (\text{Naive})$$

$$\hat{y}_{t+1} = \frac{1}{w} \sum_{i=t-w+1}^t y_i \quad (\text{Moving Average})$$

Model	MAE	RMSE	MAPE (%)
Naive	2.6121	5.0870	21.51
Moving Average	5.0816	6.8233	45.14

## 5.9 Sensitivity Analysis

Formula: Delta MAPE = MAPE\_FTS - MAPE\_Baseline.

$$\Delta MAPE = MAPE_{FTS} - MAPE_{Baseline}$$

Case	MAPE (%)	Delta (%)
method = equal-frequency	27.34	1.27
n = 9	28.40	2.33
pad = 10%	28.99	2.92

## 7. Model Configuration

Model	Config Summary
FTS	n=7, method=Equal Width, pad=5%, split=80%
ANN	epoch=90, neuron=10, layers=1, lr=0.01
ARIMA	order=(1, 1, 1)

## 8. Performance Results

Model	MAE	RMSE	MAPE (%)	Rank
FTS	3.2877	4.9877	26.07	2
ANN	2.8256	4.7718	25.51	1
ARIMA	6.7277	8.8813	70.65	3

**Best Model:** ANN

## 9. Sensitivity Analysis

Case	MAPE (%)	Delta (%)
method = equal-frequency	27.34	1.27
n = 9	28.40	2.33
pad = 10%	28.99	2.92

**Best Case:** method = equal-frequency

## 10. Auto-Generated Caption

Analisis perbandingan FTS Cheng, ANN, dan ARIMA pada Unknown Device periode 28/12/2025 - 03/01/2026 dengan 1689 titik data. FTS parameter n=7, method=equal-width, pad=5% memberi MAPE=26.07%. Model terbaik: ANN (MAPE=25.51%). Konfigurasi saat ini sudah optimal.