

X POWER / ACADEMY

Basic elements

A textbook for energy tokenizers

118 electrical elements: from a physical quantity to a measurable result and an enforceable right.

A / 041 We Electrical energy J; kWh	A / 046 P Active power W; kW	A / 054 Wloss Energy losses J; kWh
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XPower teaching classification · edition 1.0 · 23 Sep 2026

The catalogue is based on the supplied table and corrected for teaching. The number 118 defines this edition’s scope; no universal physical periodicity is assumed.

Colour shows suitability for product design. Issuance and transfer require their own legal basis.

xpower.agency / Tokenization / Basic elements

How to use this textbook

Where to start

41 → 46 → 54 → 28 → 50 → 55 → 63 → 68 → 76 → 83

Start with nos. 41, 46 and 54. Add nos. 28, 50, 55, 63, 68, 76 and 83 next. Consult the remaining entries as engineering questions arise.

A · Product basis

This quantity can define a delivery volume or verified effect. Issuance needs a contract, obligor, methodology and unique rights accounting.

B · Service condition

Helps specify quality, limits or acceptance. A standalone product requires a distinct service and payment obligation.

C · Physical foundation

Used in engineering calculations or metrology. Economic value attaches to a service, equipment, licence or proven result.

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1. What becomes an asset

A token records a specific right: delivery, service, payment or authorized action. A quantity in the table describes its physical basis. Every product needs a holder, obligated party, deliverable, deadline and acceptance rule.

Working sequence: asset → measurement → verified result → contractual right → entry in the applicable system → settlement. Keep source data and decision grounds at every transition.

A useful minimum accounting unit is asset + point + interval + product + method version + right identifier. Distributed portfolios retain traceability to each asset.

2. How to read the map

The 118 entries are an editorial teaching catalogue based on the supplied poster. They form a selection of quantities, constants and events. There is no universal finite list of all electrical properties; no physical periodicity is claimed.

A marks a useful quantitative product basis: energy, active power and losses. B specifies quality and service conditions. C explains physics and measurement. This is an educational suitability assessment, with no claim of liquidity or permission to issue.

Start with nos. 41, 46 and 54. Add nos. 28, 50, 55, 63, 68, 76 and 83 next. Consult the remaining entries as engineering questions arise.

3. Units and boundaries

kW describes power; kWh describes energy over time. A constant 10 kW load uses 30 kWh in 3 hours. Peak power requires an averaging window: a one-second maximum and a half-hour average produce different values.

For sinusoidal single-phase operation $P = UI \cos\varphi$, $Q = UI \sin\varphi$, $S = UI$, using RMS U and I . For a balanced three-phase system $P = \sqrt{3} \cdot U_{line} \cdot I \cdot \cos\varphi$. With distorted waveforms total PF = P/S can differ from fundamental displacement $\cos\varphi$.

The boundary determines which losses and auxiliary loads enter the calculation. Battery charge and discharge are measured separately; heat and cooling need their own meters and temperature conditions. [X] inherits the unit of the underlying signal.

4. Evidence and certification

A measurement passport includes instrument type and identifier, verification or calibration status under applicable rules, location, connection, timezone, sampling interval, raw data and change log. Missing or substituted data are marked explicitly.

A measurement and verification plan defines the baseline, weather and load adjustments, useful-service preservation, uncertainty and dispute resolution in advance. An intelligence model receives a version and validity range. Its accuracy is checked under new operating conditions. [S2]

For power quality, agree measurement methods and acceptance limits. IEC 61000-4-30:2025 describes measurement methods; limits and applicability depend on the grid, contract and current rules. Equipment certification, result verification, rights registration and tax accounting serve distinct purposes. [S3]

5. Rights, payments and full accounting

First identify the right and obligated party. Then choose a permitted legal form, transfer rules and settlement infrastructure. Russian digital financial assets can include monetary claims; issuance uses the prescribed information-system framework. Utility digital rights, hybrid rights and contractual claims require separate assessment at the transaction date. [S4]

Accounting separates physical volume, gross benefit, costs, tax base, reserve, recognized receivable and cash received. Each measure identifies the accounting party, supporting document, currency and period. There is no single tax rate covering all energy tokens.

Future receipts are disclosed as forecasts. Present value depends on timing, risk, costs and discount rate. Transferring a structure to Serbia or another country requires local legal and tax review.

6. Product compatibility

One asset may provide several services. Prepare a power and energy budget for every interval. Reserve, demand response, computing and native-load obligations must fit the actual constraints simultaneously.

A cancelled origin certificate is removed from the available balance. An allocated share of a receivable keeps its link to the original quantity. Overlap checks cover asset, interval, service, baseline and benefit recipient. [S7]

Reducing consumption by 10 kW, allocating those 10 kW to computing and promising the same 10 kW as reserve requires a compatibility calculation. Revenues are combined only after physical operation and contract rules have been checked.

ENERGY / Energy delivery

41 We · 46 P · 28 U · 63 Xrms

Subject of the right

A right to an agreed delivery volume or a monetary claim tied to delivery.

Who pays

Buyer under the delivery contract.

Evidence required

Meter, boundary, interval, flow direction, data quality and acceptance record.

$$W = \sum P_i \cdot \Delta t_i; \text{ payment} = \sum W_i \cdot c_i$$

Example unit: 1 kWh at a defined point and interval. Delivery rights and payment claims require their respective legal bases.

SAVE / Verified savings

41 We · 54 Wloss · 55 η · 46 P

Subject of the right

A monetary claim on a contractual share of the verified net benefit.

Who pays

Energy-service customer or another expressly obligated party.

Evidence required

Adjusted baseline, actual consumption, useful output, additional costs and uncertainty.

$$\Delta W = W_{\text{baseline,adjusted}} - W_{\text{actual}}; \text{ claim} = \text{share} \times \text{net benefit}$$

Savings are determined by comparison. Model predictions and meter readings serve different evidence roles.

FLEX / Flexibility and peak reduction

46 P · 38 τ · 64 X · 68 dX/dt

Subject of the right

A right to payment for availability and/or delivered load adjustment under programme rules.

Who pays

Aggregator, market operator or customer under the relevant contract.

Evidence required

Resource qualification, command, timestamps, load profile, baseline, response and post-event rebound.

$$\Delta P_i = P_{\text{baseline},i} - P_{\text{actual},i}; \text{ acceptance follows programme rules}$$

10 kW for 2 hours means 20 kWh less consumption during the event. Daily energy savings depend on later operation.

RESERVE / Reserve and available capacity

46 P · 41 We · 38 τ · 55 η · 83 interrupt

Subject of the right

An obligation to provide power at a specified location, duration and activation speed.

Who pays

Reserve customer or an eligible market counterparty.

Evidence required

Availability test, usable energy, charge state, temperature, degradation, auxiliaries and network limits.

$$P_{\text{available}} \leq \min(P_{\text{limit}}, E_{\text{usable}}/AC / \text{duration})$$

Battery nameplate kW must be complemented by kWh, response time, state of charge and limits.

QUALITY / Power quality

28 U · 47 Q · 48 S · 50 PF · 51 $\cos\phi$ · 74 U_2/U_1 · 76 THDu · 81 dip · 83 interrupt · 86 Pst / Plt

Subject of the right

A service maintaining agreed parameters with measurable acceptance and contractual accountability.

Who pays

Quality-service customer where the contract establishes payment.

Evidence required

Parameters, thresholds, statistics, measurement point, instrument class and unavailable periods.

Payment = service fee $\pm$ performance adjustment

Lower THD or higher PF gains a price through a contract. Percentage improvement does not equal percentage energy savings.

GRID / System support

56 f · 79 Δf · 80 df/dt · 97 Zth · 102 Hsys · 103 Kf · 104 Rd · 106 SCR

Subject of the right

A contractual frequency, voltage or other agreed grid-support service.

Who pays

Operator or service buyer under the applicable market or contract.

Evidence required

Qualification, tests, telemetry, control characteristics and verified response.

Preponse = $K_f \times \Delta f$; subject to limits and sign convention

Service eligibility is specific to the grid. Network coefficients support the technical assessment.

ORIGIN / Energy origin

41 We

Subject of the right

A right to a recognized origin attribute under the relevant certificate scheme.

Who pays

Attribute buyer under contract.

Evidence required

Registry, plant, generation period, unique certificate number, transfer and cancellation.

Attribute volume $\leq$ eligible registered generation

Origin is an additional data layer over no. 41. A token copy must preserve the link to the source registry and cancellation status.

COMPUTE / Energy for computing

46 P · 41 We · 55 η · 83 interrupt

Subject of the right

A computing service with specified hardware, workload, time and performance.

Who pays

Computing-service customer.

Evidence required

Available power, energy, cooling, connectivity, accelerators, utilization and measured task output.

Energy cost = IT power $\times$ PUE $\times$ hours $\times$ energy price

Converting kW to FLOPS requires specific hardware, numerical precision and operating conditions. PUE defines the infrastructure-energy boundary.

Worked cases

All worked-case numbers are synthetic. Formulas illustrate the calculation logic; no current tariffs or live issuances are claimed.

1. Refrigeration savings

Synthetic month: adjusted baseline 100,000 kWh, actual use 82,000 kWh, agreed value RUB 8/kWh. Additional costs RUB 24,000. Provider share 30% of benefit after costs. The temperature service is maintained.

Solution

$\Delta W = 18,000$ kWh. Gross benefit RUB 144,000. After costs RUB 120,000. Contractual share RUB 36,000; customer retains RUB 84,000. Taxes and reserves are outside this example.

Issuance relies on the contractual right and accepted calculation. All input data and the verification statement form the evidence package.

2. Load reduction with rebound

Load falls by 10 kW for 2 hours. Afterwards the equipment uses an extra 14 kWh. Assumed payment is RUB 5 per accepted event kWh. There is no availability payment.

Solution

Event reduction is 20 kWh; net energy reduction over the full cycle is 6 kWh. If all 20 kWh are accepted, payment is RUB 100. This teaching formula is not a current DR tariff.

Event volume, daily savings and market payment follow separate rules. Programme eligibility is checked separately.

3. How much reserve a battery provides

Usable AC output energy after all limits is 90 kWh. Maximum output is 40 kW. The customer needs 3 hours of continuous support. All additional losses are already included in the 90 kWh.

Solution

Permitted commitment: $\min(40, 90/3) = 30$ kW for 3 hours. At 40 kW, available duration is 2.25 hours.

The commitment is limited by energy, power and actual condition. Available volume is recalculated when charge falls.

4. Reactive-power compensation

A sinusoidal 100 kW load. Power factor rises from 0.80 to 0.95 with active power unchanged.

Solution

S falls from 125 to 105.26 kVA. Q falls from 75 to 32.87 kvar; compensation is about 42.13 kvar. At the same voltage, current falls by 15.79%.

The result can support a compensation service. Monetary savings depend on actual losses and billing terms; current reduction does not imply equal load-energy reduction.

5. Sharing a 10 kW resource

A retrofit frees 10 kW. Computing uses 8 kW in the same interval. An external command then requires another 5 kW reduction in total site consumption.

Solution

The remaining margin relative to the original load is 2 kW. A 5 kW commitment depends on authority and technical ability to curtail computing by at least another 3 kW, plus the programme baseline and rules.

Until compatibility is confirmed, the 5 kW remains a proposal. Computing auxiliaries and cooling must also be checked.

Product passport

Complete these ten fields before preparing an issuance. Missing fields identify the evidence still required.

01. Asset, owner, operator, measurement point and boundary.
02. Product, physical unit, quantity, interval and timezone.
03. Useful service, quality parameters, limits and response time.
04. Instruments, raw data, verification, methodology and uncertainty.
05. Baseline and version, adjustments, command and intervention logs.
06. Signed verification statement and dispute-resolution procedure.
07. Right holder, obligated party, jurisdiction and contractual basis.
08. Payment formula, price or index, costs, taxes and reserve.
09. Issuance cap, unique identifier, encumbrances and compatibility.
10. Transfer, due date, settlement, retirement and failure procedure.

01 / Charge and field

Physics of energy transfer and insulation limits. Deals usually need measured current and voltage.

1-12 · A / Product basis · B / Service condition · C / Physical foundation

C · 001 · q Electric charge C Amount of charge; $q = \int I \, dt$. Energy also depends on voltage.	C · 002 · ρ Volume charge density C/m^3 Charge per unit volume, used in field calculations.
C · 003 · σq Surface charge density C/m^2 Charge per unit surface area of a conductor or dielectric.	C · 004 · λq Linear charge density C/m Charge per unit length, useful for a long-conductor model.
B · 005 · I Electric current A Rate of charge flow. Heating and load limits depend on current.	C · 006 · J Current density A/m^2 Current per cross-sectional area; helps assess local heating.
C · 007 · E Electric field strength V/m Force per unit charge, used in insulation design.	C · 008 · B Magnetic flux density T Describes the magnetic field in motors and transformers.
C · 009 · D Electric displacement C/m^2 Combines the electric field and material polarization.	C · 010 · H Magnetic field strength A/m In a linear medium $B = \mu H$. Used to design magnetic circuits.
C · 011 · φ Electric potential V Potential energy per unit charge relative to a chosen reference.	C · 012 · $\mathcal{E}$ Electromotive force V Source work per unit charge; characterizes a generator or battery.

02 / Materials

Material properties explain losses, aging and equipment operating limits.

13-24 · A / Product basis · B / Service condition · C / Physical foundation

C · 013 · Ppol Polarization C/m² Electric dipole moment per unit volume of material.	C · 014 · Mmag Magnetization A/m Magnetic moment per unit volume, important for magnetic cores.
C · 015 · ε Permittivity F/m Material response to an electric field; affects capacitance.	C · 016 · μ Permeability H/m Relates flux density and magnetic field strength in a material model.
C · 017 · σ Conductivity S/m Ability to conduct current; in a simple model $J = \sigma E$.	C · 018 · ρe Resistivity Ω·m Inverse of material conductivity; depends on temperature.
C · 019 · χe Electric susceptibility 1 Dimensionless polarization response to an electric field.	C · 020 · χm Magnetic susceptibility 1 Dimensionless magnetization response to a magnetic field.
B · 021 · tanδ Dielectric loss tangent 1 Characterizes dielectric losses; supports insulation diagnostics.	B · 022 · Ebd Dielectric strength V/m Field at which breakdown can occur under specified test conditions.
C · 023 · μc Carrier mobility m²/(V·s) Relates carrier drift velocity to electric field strength.	C · 024 · n Carrier concentration m⁻³ Number of free charge carriers per unit volume.

03 / Electric circuits

Circuit parameters help calculate storage, compensation and service availability.

25-40 · A / Product basis · B / Service condition · C / Physical foundation

C · 025 · ΨD Electric displacement flux C Flux of D through a surface, related to free charge.	C · 026 · Φ Magnetic flux Wb Surface integral of magnetic flux density.
C · 027 · λ Flux linkage Wb Sum of fluxes linked by turns; determines induced voltage.	B · 028 · U Voltage V Potential difference; an essential supply characteristic at the delivery point.
B · 029 · R Resistance Ω At current I, resistive power losses equal I^2R .	C · 030 · G Conductance S Reciprocal resistance of a resistive element: $G = 1/R$.
B · 031 · C Capacitance F Ability to store charge. Ideal capacitor energy equals $CU^2/2$.	B · 032 · L Inductance H Relates current and flux linkage. A linear inductor stores $LI^2/2$.
C · 033 · M Mutual inductance H Magnetic coupling between circuits, central to transformer operation.	B · 034 · Z Impedance Ω Complex opposition to alternating current, with resistive and reactive parts.
C · 035 · Y Admittance S Reciprocal impedance: $Y = 1/Z$.	C · 036 · X Reactance Ω Imaginary part of impedance, set by capacitance and inductance.
C · 037 · Bs Susceptance S Imaginary part of admittance, used in compensation calculations.	B · 038 · τ Time constant s Characteristic transient time; affects response speed.
B · 039 · f_0 Resonant frequency Hz Resonance frequency; relevant to filters and operating stability.	C · 040 · Qf Quality factor 1 Describes losses and resonance sharpness in an oscillating system.

04 / Energy and power

The main product-design group: delivery, savings, capacity and losses.

41-55 · A / Product basis · B / Service condition · C / Physical foundation

A · 041 · W_e Electrical energy J; kWh Energy transferred over an interval: $W = \int P \, dt$; 1 kWh = 3.6 MJ.	C · 042 · W_m Magnetic energy J Energy stored in a magnetic field, for example in an inductor.
C · 043 · W_{em} Electromagnetic energy J Energy of electric and magnetic fields in the region considered.	C · 044 · u Energy density J/m ³ Energy per unit volume; useful for fields and storage.
B · 045 · $p(t)$ Instantaneous power W In a single-phase circuit $p(t) = u(t)i(t)$; energy requires integration.	A · 046 · P Active power W; kW Average rate of energy transfer over a specified interval.
B · 047 · Q Reactive power var; kvar Describes energy exchange with fields in alternating-current operation.	B · 048 · S Apparent power VA; kVA For one phase $S = U_{rms} \cdot I_{rms}$; relevant to equipment loading.
C · 049 · $\underline{S}$ Complex power VA For sinusoidal operation $\underline{S} = P + jQ$; its magnitude is apparent power.	B · 050 · PF Power factor 1 Ratio P/S . Includes waveform effects under the adopted definition of S .
B · 051 · $\cos\varphi$ Displacement factor 1 Cosine of the phase angle between fundamental voltage and current.	C · 052 · S_p Poynting vector W/m ² Electromagnetic energy flux density; $S_p = E \times H$.
C · 053 · p_v Volume power density W/m ³ Local energy conversion rate; the resistive contribution equals $J \cdot E$.	A · 054 · W_{loss} Energy losses J; kWh Energy lost within a chosen boundary; reduction requires a comparable balance.
B · 055 · η Efficiency 1; % Useful output energy divided by input energy for a specified boundary.	

05 / Time, waveform and spectrum

Specifies when and how fast an obligation is delivered and how signals are measured.

56-70 · A / Product basis · B / Service condition · C / Physical foundation

B · 056 · f Frequency Hz Cycles per second; a system condition and frequency-control parameter.	C · 057 · ω Angular frequency rad/s Rate of phase change; $\omega = 2\pi f$.
B · 058 · T Oscillation period s Duration of one cycle: $T = 1/f$. Service duration is specified separately.	C · 059 · θ Phase rad Position within a cycle relative to a chosen reference.
B · 060 · $\Delta\phi$ Phase difference rad Relative phase of two signals; important for power and synchronization.	C · 061 · X Amplitude [X] Maximum signal excursion from the chosen mean level.
C · 062 · X_{pp} Peak-to-peak value [X] Difference between the maximum and minimum signal values.	B · 063 · X_{rms} Root mean square [X] Square root of the mean squared signal; used for current and voltage.
B · 064 · X Mean value [X] Average over a stated window. Window length affects peak assessment.	C · 065 · X_{abs} Mean rectified value [X] Mean of the absolute signal value.
B · 066 · CF Crest factor 1 Peak magnitude divided by RMS; indicates sharp peaks.	C · 067 · FF Form factor 1 RMS divided by mean rectified value.
B · 068 · dX/dt Rate of change [X]/s For power, describes the rate of load increase or reduction.	B · 069 · X_h Harmonic amplitude [X] Magnitude of a selected harmonic, used in power-quality analysis.
C · 070 · S_{X(f)} Spectral density [X] ² /Hz Distribution of mean-square signal value over frequency.	

06 / Three phases and quality

Power-service acceptance conditions. Requires thresholds, intervals, instruments and event-processing rules.

71-86 · A / Product basis · B / Service condition · C / Physical foundation

B · 071 · X_1 Positive sequence [X] Balanced three-phase component with the normal phase order.	B · 072 · X_2 Negative sequence [X] Component with reversed phase order, associated with unbalance.
B · 073 · X_0 Zero sequence [X] Three in-phase components, important for neutral currents.	B · 074 · U_2/U_1 Voltage unbalance 1; % Negative-sequence voltage divided by positive-sequence voltage.
B · 075 · I_2/I_1 Current unbalance 1; % Negative-sequence current divided by positive-sequence current.	B · 076 · THDu Voltage distortion 1; % Total harmonic distortion relative to a specified reference.
B · 077 · THDi Current distortion 1; % Current distortion; limits and harmonic range must be specified.	B · 078 · h Harmonic order 1 Frequency-component index: $f_h = h \cdot f_1$. Amplitude is covered by no. 69.
B · 079 · Δf Frequency deviation Hz Difference between measured and reference frequency.	B · 080 · df/dt Rate of change of frequency Hz/s Describes how quickly frequency changes; needs a defined measurement window.
B · 081 · dip Voltage dip V; s Voltage reduction event, described by residual voltage and duration.	B · 082 · swell Voltage swell V; s Voltage increase event; requires magnitude, duration and threshold.
B · 083 · interrupt Supply interruption s; count Loss of supply under an agreed threshold; count and duration are tracked.	B · 084 · transient Transient overvoltage V; s Short transient event; sufficient instrument bandwidth is required.
B · 085 · RVC Rapid voltage change %; s Change in voltage magnitude defined by the selected measurement method.	B · 086 · Pst / Plt Flicker 1 Indices of short-term and long-term light flicker severity.

07 / Waves

Foundation for lines, communications and wireless transfer. Practical output is measured at the receiver.

87-96 · A / Product basis · B / Service condition · C / Physical foundation

C · 087 · λ_w Wavelength m Spatial wave period; $\lambda_w = v_p/f$.	C · 088 · v_p Phase velocity m/s Speed of a constant-phase point in a wave.
C · 089 · v_g Group velocity m/s Envelope speed of a narrowband wave packet in the applicable model.	C · 090 · γ Propagation constant m^{-1} Complex parameter $\gamma = \alpha + j\beta$: attenuation and phase change.
C · 091 · α_{att} Attenuation constant Np/m Describes amplitude reduction along a propagation path.	C · 092 · β Phase constant rad/m Phase change per unit length.
C · 093 · η_w Wave impedance Ω Ratio of electric to magnetic wave components.	C · 094 · δ_s Skin depth m Characteristic penetration depth of an alternating field in a conductor.
C · 095 · Γ Reflection coefficient 1 Ratio of reflected to incident waves at a specified point.	C · 096 · VSWR Standing wave ratio 1 Maximum-to-minimum standing-wave amplitude ratio.

08 / Power system

Checks grid compatibility and stability. System services require qualification in a specific market.

97-106 · A / Product basis · B / Service condition · C / Physical foundation

B · 097 · Zth Thevenin impedance Ω Equivalent network impedance at the chosen connection point.	B · 098 · Ik Short-circuit current A; kA Calculated fault current, determining protection requirements.
B · 099 · Sk Short-circuit power VA; MVA Network-strength indicator at a point; does not express usable load capacity.	B · 100 · X/R X/R ratio 1 Ratio of reactive to resistive parts of network impedance.
B · 101 · δ_p Power angle rad Angular position related to power transfer and stability.	B · 102 · Hsys Inertia constant s Stored kinetic energy normalized by rated power.
B · 103 · Kf Power-frequency characteristic W/Hz Slope of active-power change versus frequency change.	B · 104 · Rd Droop 1; % Normalized relationship between frequency and controller power changes.
B · 105 · λ_c Modal decay exponent s^{-1} In $\exp(\lambda_c t)$, the real part sets decay or growth.	B · 106 · SCR Short-circuit ratio 1 Short-circuit power divided by the chosen converter rating; a grid-strength indicator.

09 / Noise and uncertainty

Helps assess measurement confidence. Total calculation uncertainty includes more than instrument noise.

107-112 · A / Product basis · B / Service condition · C / Physical foundation

C · 107 · en Voltage noise density V/√Hz Amplitude spectral density of voltage noise in a measurement circuit.	C · 108 · in Current noise density A/√Hz Amplitude spectral density of current noise.
C · 109 · SN Noise power density W/Hz Noise power per unit bandwidth.	B · 110 · SNR Signal-to-noise ratio dB Describes how clearly a useful signal stands above noise.
C · 111 · L(f) Phase noise dBc/Hz Spectral measure of an oscillator's phase instability.	B · 112 · σy(τ) Allan deviation 1 Measure of fractional-frequency stability across averaging times.

10 / Quantum quantities

Foundation of metrology and standards. Ordinary energy deals use results from appropriately verified measurements.

113-118 · A / Product basis · B / Service condition · C / Physical foundation

C · 113 · e Elementary charge C Fundamental constant: exactly $1.602176634 \times 10^{-19}$ C.	C · 114 · G₀ Conductance quantum S Quantum quantity $G_0 = 2e^2/h$, measured in siemens.
C · 115 · R_K Von Klitzing constant Ω $R_K = h/e^2$; used in quantum resistance standards.	C · 116 · K_J Josephson constant Hz/V $K_J = 2e/h$; relates frequency and voltage in the Josephson effect.
C · 117 · Φ₀ Magnetic flux quantum Wb $\Phi_0 = h/(2e)$; underlies superconducting measuring devices.	C · 118 · α_{fs} Fine-structure constant 1 Dimensionless electromagnetic coupling constant, approximately 1/137.

Editorial corrections

The catalogue is based on the supplied table and corrected for teaching. The number 118 defines this edition's scope; no universal physical periodicity is assumed.

1. Repeated numbers and duplicate cells are consolidated. Numbers 1-118 serve as learning-card addresses.
2. No. 11 is electric potential φ ; magnetic flux is no. 26. No. 45 is $p(t)$, and no. 46 is P .
3. Nos. 71-73 use X_1 , X_2 , X_0 : units depend on voltage or current. No. 78 is clarified as harmonic order h ; amplitude remains no. 69.
4. Entries 81-85 show quantities describing the events. No. 103 is K_f in W/Hz. No. 105 is explicitly tied to $\exp(\lambda_c t)$.
5. For nos. 114-117 formulas and units are separated: S , Ω , Hz/V, Wb. No. 118 is approximately $1/137$ with unit 1.

The boundary determines which losses and auxiliary loads enter the calculation. Battery charge and discharge are measured separately; heat and cooling need their own meters and temperature conditions. $[X]$ inherits the unit of the underlying signal.

Sources

Official pages and open learning resources. Checked 23 Sep 2026. The A/B/C classification and examples are XPower editorial work.

S1 · BIPM · SI Brochure

Units and definitions; ninth edition, 2026 update.

S2 · EVO · Measurement & Verification

Savings assessment through comparison and adjustments.

S3 · IEC 61000-4-30:2025

Power-quality measurement methods; official entry, corrected 2026-07. The full standard is paid.

S4 · Bank of Russia · Digital financial assets

Digital-rights and infrastructure guidance. Check conditions at issuance.

S5 · SO UPS · Demand response

Documents and materials on Russian demand response.

S6 · PJM · Regulation Market

An example of a regulation-services market. PJM rules do not automatically apply elsewhere.

S7 · AIB · Guarantees of Origin

Origin-registry participation: receipt, transfer and cancellation.

S8 · NIST · Fundamental Physical Constants

Fundamental constants and metrology; CODATA 2022 values.

S9 · OpenStax · University Physics, Volume 2

Open textbook for further study of alternating-current circuits.