



Electromagnetic compatibility (EMC)

Part 3.100: Limits—Steady state voltage limits in public electricity systems

STANDARDS
Australia



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 - Consumers Federation of Australia
 - Electrical Regulatory Authorities Council
 - Energy Networks Association
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-

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Australian Standard[®]

Electromagnetic compatibility (EMC)

**Part 3.100: Limits—Steady state voltage
limits in public electricity systems**

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee EL-034, Power Quality. After consultation with stakeholders in both countries Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

This Standard incorporates Amendment No. 1 (March 2016). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to—

- (a) define and describe the limits of the steady state supply voltage variation in public electricity systems at the customer connection points;
- (b) provide a consistent methodology for the assessment of steady state voltage parameters using power quality monitors; and
- (c) provide recommended threshold voltage levels for the detection of voltage dips and voltage swells that are consistent with the prescribed steady state voltage limits.

This Standard is structured so that all requirements are in the main section of the Standard and all recommendations and illustrative examples are in the Appendices.

This Standard is intended to be adopted by International Electrotechnical Commission (IEC) as an International Standard. Therefore the Standard number has been allocated in alignment with the IEC 61000-3 *Electromagnetic compatibility (EMC)—Limits* series Standards.

The term ‘informative’ has been used in this Standard to define the application of the appendices to which it applies. An ‘informative’ appendix is only for information and guidance.

In selecting the parameters which serve to protect electricity customers from wide variations of steady state voltage, special consideration was given to IEC 60038 and AS 60038, *Standard voltages*. All the 230 V steady state voltage limits used in this Standard have been selected to be within the range specified within IEC 60038 and having due regard to AS 60038 in Australian conditions. The strategy used in selecting the steady state voltage ranges has been based on the following:

- (i) The 230 V $\pm 10\%$ specified in IEC 60038 is a generic all inclusive range that broadly and simultaneously covers the historic ranges 240 V $\pm 6\%$ and 220 V $\pm 6\%$. A 230 V $\pm 6\%$ range also sits within the wider 230 V $\pm 10\%$ range. IEC 60038 specifies what a 230 V nominal voltage means but does not specify the power quality measurement requirements.
- (ii) A 230 V $\pm 10\%$ (total 20%) range of steady state voltage at the customer connection point is too wide for all existing customer equipment to operate effectively and efficiently. While many items of customer equipment operate effectively and efficiently over the wide steady state voltage range, some items of customer equipment are sensitive to steady state voltage levels including:
 - (A) Incandescent lighting.
 - (B) Discharge lighting incorporating fixed impedance ballasts (as distinct from electronic ballasts).

- (C) Resistive devices that are required to provide instantaneous heating including electric toasters, electric radiators, instantaneous electric water heaters, clothes dryers, hair dryers and many electric cooking appliances.
- (D) Electric motors (non-variable speed drive types).
- (iii) A total supply steady state voltage range of 16% and a preferred sub-range of 8% is considered appropriate and achievable by network service providers and is in line with keeping distribution network losses at reasonable levels. This range is consistent with AS 60038.
- (iv) The preferred 8% sub-range encourages network service providers to provide steady voltage that is closer to the 230 V nominal level where manufacturers tend to optimize the performance of their equipment to meet 'Mandatory Energy Performance Standards' test requirements. The preferred 8% sub-range also is aimed to cater for short duration voltage rise effects of distributed embedded generation, especially small scale photovoltaics.
- (v) Recommended voltage swell measurement thresholds have generally been set at 4% above $V_{99\%}$ levels and recommended voltage dip measurement thresholds have been set at 4% below $V_{1\%}$ levels. While voltage swell and dip thresholds have been recommended in this Standard, possible future limits on the frequency of such occurrences remains a subject for further research.

This Standard has set limits on $V_{1\%}$ and $V_{99\%}$ percentile values in preference to $V_{0\%}$ and $V_{100\%}$ values due to the following reasons:

- (1) To filter out erroneous and non-representative steady state measurements that sometimes occur during the power quality monitoring process. These sometimes occur when instruments are connected/disconnected and during short duration network disturbances.
- (2) To accommodate the impacts of short duration power system switching events.
- (3) To alert equipment manufacturers that steady state voltages can and will move outside the $V_{1\%}$ to $V_{99\%}$ range.
- (4) To provide consistency with many other power quality standards where limits are defined in terms of statistical quantities.
- (5) To provide greater consistency and reproducibility when repeat measurement surveys are completed.

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FOREWORD

This Standard describes characteristics of electricity in terms of the steady state alternating voltage. With respect to the utilization of electricity, it is desirable that the supply voltage would alternate at a constant frequency, with a perfect sine wave shape and at constant magnitude. In practice, there are many factors which cause departures from this ideal.

The flow of energy to the customer's appliances gives rise to electric currents which are more or less proportional to the magnitudes of the customers' demands. The new trend of widespread use of embedded generation within customer installations is placing new requirements on networks and customer installations as they have to cater for bidirectional power flows. As these currents flow through the conductors of the supply system, they give rise to voltage drops and voltage rises. The magnitude of the supply voltage for an individual customer at any instant is a function of the cumulative voltage drops and voltage rises on all the components of the system through which that customer is supplied. Steady state voltage levels are ultimately determined both by individual customer demands, network impedances and the interaction of tap changing transformers. Since each customer's demand varies over time, steady state voltage levels are also varying over time. For this reason, this Standard deals with the voltage characteristics in statistical or probabilistic terms.

It is in the economic interests of the overall community that the standard of electricity supply should relate to normally expected conditions rather than to rare contingencies, such as unusual levels of peak demand and abnormal switching configurations brought about by network faults.

This Standard defines allowable variations of steady state voltage that electricity customers can expect when connected to a public electricity network under normal operating conditions.

Since there is a considerable diversity in the structures of the distribution systems in different areas arising from differences in load density, population, dispersion, local topography, etc. many customers will experience considerably smaller variations of the voltage characteristics than the limits provided in this Standard for most of the time.

This Standard is designed to provide compatibility levels between time variations of steady state supply voltage supplied and the electrical equipment being supplied. Changes to equipment standards will be required to achieve the desired compatibility. It should be especially noted that despite the existence of this Standard, the performance of equipment might be impaired if the equipment is subject to supply conditions more severe than specified in their product Standard.

This Standard also provides recommended threshold voltage levels for the detection of voltage dips and voltage swells. Defining these levels in this Standard is opportune because they need to be closely correlated with the steady state voltage upper and lower limits.

STANDARDS AUSTRALIA

**Australian Standard
Electromagnetic compatibility (EMC)****Part 3.100: Limits—Steady state voltage limits in public electricity systems****1 SCOPE**

This Standard specifies the steady state voltage limits in low voltage and medium voltage public electricity systems at the customer connection point.

Electricity customers and equipment manufacturers can use limits of steady state supply voltages in combination with knowledge of voltage drop in customer installations to assess that range of steady state voltage levels that can be expected to be applied to electrical and electronic equipment under normal operating conditions.

This Standard also recommends threshold limits for the detection of voltage dips and voltage swells. Although recommended voltage thresholds for voltage dips and voltage swells are contained in this Standard, no limits are set on voltage dip or voltage swell performance.

2 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard.

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS/NZS

61000 Electromagnetic compatibility (EMC)

61000.4.30 Part 4.30: Testing and measurement techniques—Power quality measurement methods

3 DEFINITIONS

For the purposes of this Standard, the following definitions apply:

3.1 Connection point

The agreed point of supply established between a network service provider and a customer's installation.

3.2 Customer

The end user of electricity.

3.3 High voltage (hv)

A voltage, used for the supply of electricity, whose nominal r.m.s. value lies at or above 10 kV.

3.4 Highest voltage for equipment (U_m)

The highest r.m.s. value of phase-to-phase voltage for which the equipment is designed in respect of its insulation as well as other characteristics which relate to this voltage in the relevant equipment standards.

3.5 Hysteresis

The difference in magnitude between the start and end thresholds.