Electromagnetic Compatibility Data for Lifts, Elevators and Escalators

1 Purpose

This EMC data sheet gives specific information for the Unidrive SP, Unidrive ES and Commander SK drive ranges when used in lifts, elevators and escalators which are required to comply with the the harmonised European EMC standards **EN 12015** (emission) and **EN 12016** (immunity).

These standards were revised in 2004, although in some EU countries the revised versions did not become available until 2006. The revised versions became mandatory in **June 2006**. They contain some important changes from the previous (1998) versions. The information given here includes the requirements of the revised versions.

This data sheet should be read in conjunction with the relevant *User Guide* or *Installation Guide,* and the EMC data sheet for the specific drive module to be used. These give specific installation instructions which are necessary to ensure conformity with the EMC standards.

2 Product

The drive models covered by this document are:

SP1406 SP2401, SP2402, SP2403, SP2404 SP3401, SP3402, SP3403 SP4401, SP4402, SP4403 SP5401	ES1406 ES2401, ES2402, ES2403, ES2404 ES3401, ES3402, ES3403 ES4401, ES4402, ES4403 ES5401	SKA1200025, SKA1200037 SKA1200055, SKA1200075 SKBD200110, SKBD200150, SKB3400037, SKB3400055, SKB3400075, SKB3400110 SKB3400150 SKCD200220, SKC3400220 SKC3400300, SKC3400400

3 Emission - EN 12015

The standard sets limits in the following categories:

1. Radiated emission from the enclosure

This covers the frequency range 30 MHz to 1000 MHz.

The limits are the same as for the generic standard EN 61000-6-4 and are unchanged from the 1998 version.

2. Conducted emission from the AC mains port(s)

This covers the frequency range 0.15 MHz to 30 MHz.

The limits are the same as for the generic standard EN 61000-6-4 and are unchanged from the 1998 version.

3. Conducted emission from the power port(s) (motor port etc.)

This covers the frequency range 0.15 MHz to 30 MHz.

These are new limits, which apply unless the motor cable length does not exceed 2m or it is screened.

4. Impulse noise

This is a special requirement for impulsive conducted emission.

The limits are the same as for the 1998 version.

5. Voltage fluctuations

This covers fluctuations, which are variations in the supply voltage which result in lighting flicker.

These are new limits. They are based on the standard EN 61000-3-11.

6. Mains current harmonics

This covers harmonics up to order 40.

These are new limits. They are based on standard IEC 61000-3-4.

3.1 Conformity of the Control Techniques drive products with EN 12015

The drives conform to the standard for Power Drives Systems, EN 61800-3, and the generic standard for industrial environments EN 61000-6-4. In many respects this also covers the requirements of EN 12015.

Table 3-1

Drive type	Radiated emission	Mains conducted emission	Maximum motor cable length m	Output conducted emission	Impulse noise	Voltage fluctuations	Mains current harmonics
ES, SP1406	Conform	Conform	25	N/A	N/A	Conform	Conform
ES, SP240X	Conform	Conform	25	N/A	N/A	Conform	Conform
ES, SP340X	Conform	Conform	50	N/A	N/A	Conform	Conform
ES, SP440X	Conform	Conform	100	N/A	N/A	Conform	Conform
ES, SP540X	Conform	Conform	100	N/A	N/A	Conform	Conform
SKA	Conform	Conform	50	N/A	N/A	Conform	See note 2.
SKB single phase	Conform	Conform	75	N/A	N/A	Conform	See note 2.
SKB 3 phase 200V	Conform	Conform	75	N/A	N/A	Conform	See note 2.
SKB 3 phase 400V	Conform	Conform	100	N/A	N/A	Conform	See note 2.
SKC single phase	Conform	Conform	100	N/A	N/A	Conform	See note 2.
SKC 3 phase 200V	Conform	Conform	75	N/A	N/A	Conform	See note 2.
SKC 3 phase 400V	Conform	Conform	75	N/A	N/A	Conform	Conform

Notes to the table

1. In all cases installation must be in accordance with the guidance given in the *User Guide, Installation Guide or EMC data sheet* for conformity to the generic emission standard.
2. The smaller Commander SK models can be made to comply with harmonic limits in their own right, by the use of suitable input chokes, but this will generally not be needed, see section 3.6 *Mains current harmonics* below. Some additional requirements are specified in section 3.6.

3.2 Mains conducted emission

Generally the standard optional external filter must be used.

The motor cable length is set by the filter capability, on the assumption that the highest available switching frequency is in use. If longer lengths are required this can usually be achieved by reducing the switching frequency, see the appropriate EMC data sheet for further information.

Where the lift system has a rated input current exceeding 100A, and a dedicated supply transformer, higher emission levels are permitted and then only the built-in filter is required.

Please note that the standard test method requires the use of a mains supply cable 1m long, this being the cable which connects the system under test to the LISN (line impedance stabilisation network). This requirement might be inconvenient and appear to be unrealistic in some cases. However it is important to adhere to this recommendation to ensure a valid and comparable test result.

3.3 Output conducted emission

The cable must be screened and the screen must be correctly bonded in accordance with the *EMC (Electromagnetic compatibility)* section of the *User Guide or the EMC data sheet* for the product, unless the motor cable length is less than or equal to 2m in length.

3.4 Impulse noise

The drive does not generate impulse noise. Care is required to ensure that associated power contactors do not generate impulse noise.

3.5 Voltage fluctuations

The drive does not in itself cause significant voltage fluctuations or flicker. The control system must be designed so as not to cause rapid changes in motor power which could result in flicker. Generally the requirements for passenger comfort ensure that this is the case.

3.6 Mains current harmonics

The mains current harmonics for the complete lift system will be the vector sums of the harmonic currents for all of the individual electrical loads in the system. Usually the main lift drive(s) will dominate the electrical load, and it will be sufficient to ensure that these meet the harmonic requirements. Where electronic drives are also used for ancillary functions such as door opening, ventilation etc., it may be necessary to ensure that their harmonic contributions are not excessive, although generally their power ratings will be too small to be significant. It is important that test conditions should be realistic and/or calculations done correctly, in order for harmonic emission from small drives to be correctly assessed. Please see the note below on test conditions for harmonic testing.

The information below shows the measures required for drives rated at 2.2kW upwards, in order to meet the harmonics requirements. For harmonic data related to the smaller drives which might be used for auxiliary functions, please refer to the relevant EMC data sheet.

Input chokes must be provided in order to maintain the harmonics below the required levels. The table gives the choke data. Note that the correct value of choke depends upon the maximum input power for which the particular lift controller is designed, and not necessarily on the drive model number or rating. The figure for input power in the table is based on the efficiency of a typical standard Eff2 induction motor. For a given application, it is important that the actual maximum input power should be measured or estimated and the necessary choke value calculated in inverse proportion to the power.

Table 3-2

Drive	Choke value mH	Current rating A	Input power W
ES, SP1406	6.6	7.5	4751
ES, SP2401	4.5	10	6322
ES, SP2402	3.3	13.6	8620
ES, SP2403	2.0	19.5	12360
ES, SP2404	1.3	26.4	16780
ES, SP3401	1.6	26.5	16780
ES, SP3402	1.3	32.4	20490
ES, SP3403	1.0	38.3	24260
ES, SP4401	0.6	51.5	32790
ES, SP4402	0.6	63.1	40000
ES, SP4403	0.5	76.5	48490
ES, SP5401	0.38	94	58760
SKC3400220	12	4.3	2716
SKC3400300	9	5.7	3632
SKC3400400	6.6	7.5	4751

The actual harmonic behaviour is shown below in comparison with the requirements of EN 12015:

Table 3-3

Item	Limit (%)	Typical (%)
Harmonic:		
5	30	27.6
7	18	7.9
11	13	6.4
13	8	3.7
THD	35	29.9
PWHD	39	16.5
cosϕ		0.9790
Distortion Factor		0.9580
Power Factor		0.9379

The limits in the table are based on the ratios of the specific harmonics to the rated fundamental current (I_n / I_1 in clause 6.7.2 of EN 12015:2004).

4 Important note on test conditions and calculations for harmonic emission testing

The requirements of EN 12015 for harmonic current emission testing are:

- Test methods to be in accordance with IEC/TR2 61000-3-4
- Ratios I_n / I_1 to be derived from instantaneous measurements of the fundamental and harmonic currents
- Ratios I_n / I_1 for comparison with the limits given in Table 3-3 to be based on a fundamental current that is at least the rated current of the system defined by the manufacturer.

The fundamental current is determined by the electrical power consumed by the system, which depends primarily upon the mechanical load power delivered and the system efficiency. In order for all of the requirements above to be met, the value of I_1 in the test must be equal to the rated value of I_1.

This means that the harmonic test must be carried out with the lift running at rated load power, i.e. at rated speed and load. This can present considerable practical difficulties, since it will not normally be possible to load the lift machinery with the intended lift car when testing in an EMC test house. It might be possible to provide a temporary load, for example by partially applying the brake. For a site test it is more likely to be possible to provide a load, but the special equipment (sinusoidal amplifiers etc.) required for the test is not easily transportable to a site.

Every effort should be made to ensure that the test is carried out at the correct rated load.

Because of these difficulties, there may be a tendency for the test to be carried out at part load or even no load. Typically the resulting measured values of I_n / I_1 etc. are based on the actual measured fundamental current during the test, since this is the requirement of the standard, and also the test equipment used for this purpose is designed to calculate the results in this way. Then it is very likely that the limits required by the standard will not be met. This is because the harmonics as a proportion of the actual fundamental current increase with reducing load, even though the main limiting harmonics (5th and 7th) fall in absolute terms.

To conform to the standard correctly, it is essential that the correct rated load be applied. If this cannot practically be achieved then the only realistic course of action is to scale the results in the ratio of the actual fundamental current during the test to the rated fundamental current - which can be calculated from the rated input power and the rated supply voltage*.

* If there is a significant inductive load, such as a direct-on-line motor, then account must be taken of its power factor (cosϕ)

5 Immunity - EN 12016

The standard gives immunity requirements over a range of standard immunity test methods. Generally these correspond to the tests required by the generic standards for the residential and industrial environments, EN 61000-6-1 and EN 61000-6-2. However there are more severe test levels prescribed for safety circuits. In the tests for safety circuits, the drive is permitted to trip but the safety function must continue to operate.

The following table shows the status of the whole range of drives covered by this data sheet.

Test	Status – drive functions	Status – SECURE DISABLE used in safety circuits - Unidrive SP and ES only
Electrostatic discharge	Conform	Conform
Radio frequency electromagnetic field	Conform	Conform (the drive might trip but no loss of safety function)
Fast transients common mode – to signal and power ports	Conform	Conform
Surge: Signal and control lines Power ports	 Conform Conform	 Conform (External suppression is required to prevent trip or damage*) Conform
Radio frequency common mode – to signal and power ports	Conform	Conform
Voltage dips	Conform	Conform
Voltage interruptions	Conform	Conform

* Suppression is not required to ensure safety, and is generally not required. Control Techniques recommends that the suppression be fitted if the lines connected to the port exceed 30m in length, based on the requirements of EN 61000-6-2.

5.1 Surge suppression

Additional over-voltage suppression - for the analogue and digital inputs and outputs, a zener diode network or a commercially available surge suppressor may be connected in parallel with the input circuit as shown in Figure 5-1 and Figure 5-2.

If a digital port experiences a severe surge its protective trip may operate (O.Ld1 trip code 26). For continued operation after such an event, the trip can be reset automatically by setting Pr **10.34** to 5.

Figure 5-1 Surge suppression for digital and unipolar inputs and outputs

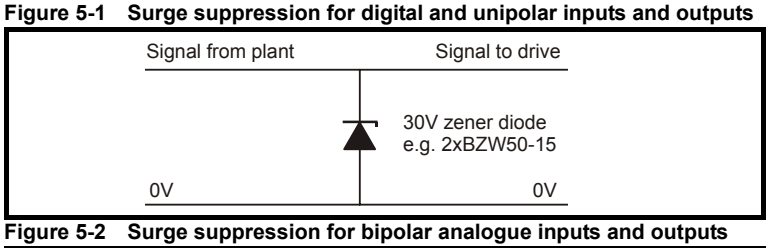
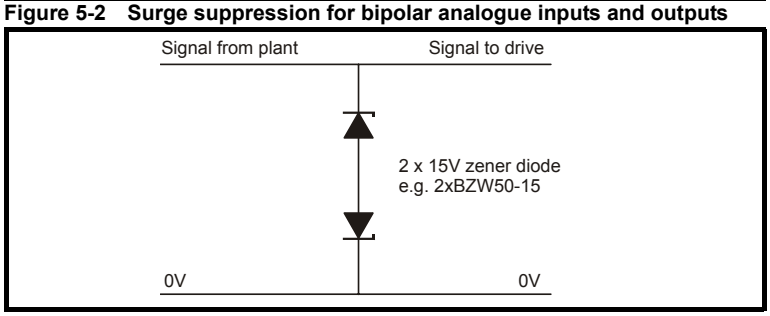


Figure 5-2 Surge suppression for bipolar analogue inputs and outputs



Surge suppression devices are available as rail-mounting modules, e.g. from Phoenix Contact GmbH:

Unipolar TT-UKK5-D/24 DC
Bipolar TT-UKK5-D/24 DC

These devices are not suitable for encoder signals or fast digital data networks because the capacitance of the diodes adversely affects the signal. Most encoders have galvanic isolation of the signal circuit from the motor frame, in which case no precautions are required. For data networks, follow the specific recommendations for the particular network.