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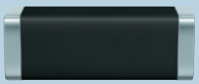
Sample Kit 2011



# Multilayer Varistors (MLVs)

## for ESD and High Energy Transient Protection in Automotive Applications

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# What are multilayer varistors (MLVs)?

- MLVs are multilayer semiconductor ceramic components for ESD protection of safety-relevant data lines and bus systems and for high-energy transient protection (e.g. load dump and jump start) in automotive electronic devices.
- MLVs can replace semiconductor diodes.

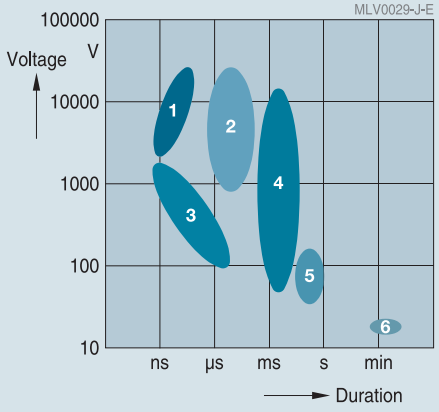
# Benefits for customer applications

- Bidirectional protection for ESD and high energy transients
- Low capacitance types for bus systems
- Use of parasitic capacitance for RFI suppression and RF filtering (replacement of additional MLCC)
- High signal integrity due to low non-linearity → no signal distortion
- Use at temperatures up to 150 °C
- No temperature derating up to 125 °C/150 °C (depending on type)
- High energy handling capability
- Low parasitic inductance
- Low leakage current
- Fast response time < 0.5 ns

# Qualification

- Reliability based on AEC-Q200, Rev. C
- ESD protection according to IEC61000-4-2 and ISO10605
- Jump start and load dump protection to ISO7637

## Overview of transient overvoltages




1. Electrostatic discharge (ESD)
2. Surge (high energy transients µs)
3. Burst (fast transient single pulse ns)
4. Switched inductive loads
5. Load dump
6. Jump start

# Selection Guide

## Typical requirements for automotive applications

**ESD protection.**
Typical applications: Bus systems, car infotainment. Typical case sizes: 0603, 0805

- ESD specification (e.g. IEC, ISO, AEC, JEDEC, HBM, customer specification)
- Type of bus system (e.g. LIN, CAN, FlexRay) defines capacitance requirement on protection device
  - Special capacitance range (controlled capacitance, low capacitance, high-speed)
  - Enhanced temperature requirement (150 °C)
    - High temperature (HT) range

**Load dump/jump start protection.**
Typical application: battery line. Typical case sizes: 1210, 2220

- Load dump / jump start requirements (e.g. ISO 7637)
- Additional requirements (e.g. centralized or module protection)
  - AUTO range
  - Enhanced temperature requirement (150 °C)
    - AUTO high temperature range

**Transient voltage/RFI suppression.**
Typical application: DC motors. Typical case sizes: SR1 (1812), SR2 (2220), SR6 (1206)

- RFI suppression requirements:
  Noise suppression level (e.g. VDE 0879, part 3), capacitance value, frequency range
- Additional requirements (e.g. load dump, jump start, ISO 7637, JASO)
- Leaded transient voltage / RFI suppressors (SHCV) [1)]

**Surge current protection.**
Typical application: motors. Typical case sizes: 3225, 4032

- Additional requirements (e.g. load dump, jump start)
- SMD disk varistors AUTO range (CU AUTO) [1)]

[1)] For samples or further information please contact your EPCOS sales office.

# Product Range

## Electrical parameters of parts in the sample kit

| Case size | EPCOS type | $V_{DC}$ [V] | $I_{surge,\,max}$ @ 8/20 µs [A] | $W_{max}$ @ 2 ms [mJ] | $W_{LD}$ @ 10 pulses [J] | $P_{diss,\,max}$ [mW] | $V_V$ @ 1 mA*) [V] | $V_{jump}$ @ 5 min. [V] | $V_{clamp,\,max}$ [V] | $I_{clamp}$ @ 8/20 µs [A] | $C_{typ}$ [pF] | $C_{max}$ [pF] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUTO range** | | | | | | | | | | | | |
| 0805 | CT0805S14BAUTOG | 16 | 120 | 300 | 1 | 8 | 22 | 24.5 | 42 | 1.0 | 400 | – |
| 1206 | CT1206K20AUTOG | 26 | 200 | 700 | 1.5 | 8 | 33 | 27.0 | 54 | 1.0 | 600 | – |
| 1210 | CT1210S14BAUTOG | 16 | 400 | 1600 | 3 | 10 | 22 | 24.5 | 40 | 2.5 | 1700 | – |
| 1210 | CT1210K17AUTOG | 22 | 400 | 1700 | 3 | 10 | 27 | 26.5 | 44 | 2.5 | 1800 | – |
| 1210 | CT1210K20AUTOG | 26 | 400 | 1900 | 3 | 10 | 33 | 27.0 | 54 | 2.5 | 1500 | – |
| 1210 | CT1210K25AUTOG | 31 | 300 | 1700 | 3 | 10 | 39 | 29.0 | 65 | 2.5 | 1200 | – |
| 2220 | CN2220S14BAUTOGK2 | 16 | 1200 | 5800 | 12 | 30 | 22 | 24.5 | 40 | 10.0 | 9500 | – |
| 2220 | CN2220S14BAUTOE2G2K2 | 16 | 1200 | 5800 | 25 | 30 | 22 | 24.5 | 40 | 10.0 | 15000 | – |
| 2220 | CN2220K30AUTOE2G2K2 | 34 | 1200 | 12000 | 25 | 30 | 47 | 45.0 | 77 | 10.0 | 10000 | – |
| **Standard and special capacitance range** | | | | | | | | | | | | |
| 0603 | CT0603K25G | 31 | 30 | 300 | – | 3 | 39 | – | 67 | 1 | 90 | – |
| 0805 | CT0805K25G | 31 | 80 | 300 | – | 5 | 39 | – | 67 | 1 | 250 | – |
| 0603 | CT0603K17LCG | 22 | 10 | 100 | – | 1 | 27 | – | 50 | 1 | – | 50.0 |
| 0603 | CT0603S17BCCG | 22 | 30 | 75 | – | 3 | 25 | – | 50 | 1 | – | 74.2 |
| 0603 | CT0603S17ALCG | 22 | 30 | 75 | – | 3 | 25 | – | 50 | 1 | – | 75.0 |
| 0603 | CT0603K14G | 18 | 30 | 200 | – | 3 | 22 | – | 40 | 1 | 100 | – |
| 0603 | CT0603S14AHSG | 16 | 5 | 30 | – | 3 | 23 | – | 66 | 1 | 15 | 30.0 |
| 0603 | CT0603L25HSG | 32 | 5 | – | – | | 51.9 | – | 120 | 1 | 10 | 15.0 |
| **AUTO high temperature range** | | | | | | | | | | | | |
| 0603 | CN0603S14BHTG2 | 18 | 30 | 200 | – | 3 | 22 | – | 42 | 1 | 120 | – |

*) Tolerances see data sheet on CD-ROM

# Components

| CT0805 S14BAUTOG | CT1206 K20AUTOG | CT1210 S14BAUTOG | CT1210 K17AUTOG | CT1210 K20AUTOG | CT1210 K25AUTOG | CN2220S14 BAUTOGK2 | CN2220S14 BAUTOE2G2K2 | CN2220K30 AUTOE2G2K2 |
|---|---|---|---|---|---|---|---|---|

| CT0603 K25G | CT0805 K25G | CT0603 K17LCG | CT0603 S17BCCG | CT0603 S17ALCG | CT0603 K14G | CT0603 S14AHSG | CT0603 L25HSG | CN0603 S14BHTG2 |
|---|---|---|---|---|---|---|---|---|

# Application Matrix for High-Runner Types

| Application examples | Power windows | Mirror controls | Central door looking | Sun roofs | Rain sensors | Windshield wipers | Seat adjustment | Airbag | Car radio | Power train | Electronic acceleration | ABS | ESP | Gearbox | Drive and chassis control | Brake by wire | Steer by wire | Shift by wire | Entertainment | Navigation | Video |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUTO range: Load dump/jump start suppression (centralized or on module)** | | | | | | | | | | | | | | | | | | | | | |
| CT0805S14BAUTOG | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CT0805K25AUTOG | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CT1206S14BAUTOG | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CT1206K25AUTOG | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CT1210S14BAUTOG | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CT1210K25AUTOG | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CN1812S14BAUTOG | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CN1812S14BAUTOE2G2 | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CN2220S14BAUTOGK2 | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CN2220S14BAUTOE2G2K2 | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CN2220K30AUTOGK2 | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| CN2220K30AUTOE2G2K2 | | | | | | | x | x | | x | x | x | x | x | x | x | x | | | | |
| **Standard and special capacitance range: ESD protection and filtering in bus systems and datalines** | | | | | | | | | | | | | | | | | | | | | |
| Bus system | LIN | | | | | | CAN class A/B | | | CAN class C | | | | | | Flex Ray | | | MOST | | |
| Data rate | 20 kbit/s | | | | | | 10 to 100 kbit/s | | | 100 kbit/s to 1 Mbit/s | | | | | | 10 Mbit/s | | | 25 Mbit/s | | |
| CT0603K25G | x | x | x | x | x | x | x | x | x | | | | | | | | | | | | |
| CT0805K25G | x | x | x | x | x | x | x | x | x | | | | | | | | | | | | |
| CT0603K17LCG | x | x | x | x | x | x | x | x | x | | | | | | | | | | | | |
| CT0603S17BCCG | x | x | x | x | x | x | x | x | x | | | | | | | | | | | | |
| CT0603S20ACCG | x | x | x | x | x | x | x | x | x | | | | | | | | | | | | |
| CT0603S17ALCG | x | x | x | x | x | x | x | x | x | | | | | | | | | | | | |
| CT0805K17LCG | x | x | x | x | x | x | x | x | x | | | | | | | | | | | | |
| CT0603K14G | x | x | x | x | x | x | x | x | x | | | | | | | | | | | | |
| CT0603S14AHSG | | | | | | | | | | x | x | x | x | x | x | x | x | x | x | x | x |
| CT0603L25HSG | | | | | | | | | | x | x | x | x | x | x | x | x | x | x | x | x |
| **AUTO high temperature range: ESD protection in bus systems and overvoltage protection in high-temperature applications (hybrid systems)** | | | | | | | | | | | | | | | | | | | | | |
| Bus system | LIN | | | | | | CAN class A/B | | | CAN class C | | | | | | Flex Ray | | | MOST | | |
| Data rate | 20 kbit/s | | | | | | 10 to 100 kbit/s | | | 100 kbit/s to 1 Mbit/s | | | | | | 10 Mbit/s | | | 25 Mbit/s | | |
| CN0603S14BHTG2 | | | | | | | x | x | x | | | | | | | | | | | | |
| CN0603S17BHTG | | | | | | | x | x | x | | | | | | | | | | | | |

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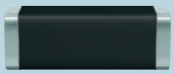

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1. Data sheet 2. General information 3. PSpice model 4. Presentation

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