

## AC Line Rated Ceramic Disc Capacitors Class X1, 440 V<sub>AC</sub>, Class Y2, 300 V<sub>AC</sub>


**ADDITIONAL RESOURCES**


| QUICK REFERENCE DATA       |        |               |     |     |
|----------------------------|--------|---------------|-----|-----|
| DESCRIPTION                | VALUE  |               |     |     |
| Ceramic Class              | 1      | 2             |     |     |
| Ceramic Dielectric         | N750   | Y5S, Y5U, Y5V |     |     |
| Voltage (V <sub>AC</sub> ) | 300    | 440           | 300 | 440 |
| Min. Capacitance (pF)      | 10     | 68            |     |     |
| Max. Capacitance (pF)      | 47     | 10 000        |     |     |
| Mounting                   | Radial |               |     |     |

**OPERATING TEMPERATURE RANGE**

-40 °C to +125 °C

**TEMPERATURE CHARACTERISTICS**

Class 1: N750 (U2J)

Class 2: Y5S, Y5U, Y5V

**SECTIONAL SPECIFICATIONS**

Climatic category (according to EN 60058-1)

Class 1 and class 2: 40/125/21

**COATING**

According to UL 94 V-0

Epoxy resin, isolating, flame retardant

**APPROVALS**

IEC 60384-14.4

UL 60384-14

DIN EN 60384-14

CSA E60384-1:03, CSA E60384-14:09

CQC11-471112

**PACKAGING**

Bulk, tape and reel, taped ammpack

**FEATURES**

- Complying with IEC 60384-14 4<sup>th</sup> edition
- High reliability
- Vertical (inline) kinked or straight leads
- Singlelayer AC disc safety capacitors
- Material categorization:  
for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

**APPLICATIONS**

- X1, Y2 according to IEC 60384-14.4
- Across-the-line
- Line by-pass
- Antenna coupling

**DESIGN**

The capacitor consists of a ceramic disc which is silver plated on both sides. Connection leads are made of tin plated copper-clad steel having a diameter of 0.6 mm.

The capacitors may be supplied with vertical (inline) kinked leads having a lead spacing of 5.0 mm, 7.5 mm, 10.0 mm, or 12.5 mm. Encapsulation is made of flame retardant epoxy resin in accordance with UL 94 V-0.

**CAPACITANCE RANGE**

10 pF to 0.01 μF

**RATED VOLTAGE U<sub>R</sub>**

IEC 60384-14 and UL 60384-14:

 (X1): 440 V<sub>AC</sub>, 50 Hz

 (Y2): 300 V<sub>AC</sub>, 50 Hz

 1000 V<sub>DC</sub>
**TEST VOLTAGE**

Component test (100 %):

 2600 V<sub>AC</sub>, 50 Hz, 2 s

 (2600 V<sub>AC</sub> for LS 7.5 mm and above)

 (2200 V<sub>AC</sub> for LS 5.0 mm)

Random sampling test (destructive test):

 2600 V<sub>AC</sub>, 50 Hz, 60 s

Voltage proof of coating (destructive test):

 2600 V<sub>AC</sub>, 50 Hz, 60 s

**INSULATION RESISTANCE**

≥ 10 000 MΩ

**CAPACITANCE TOLERANCE**

± 20 % (code M); ± 10 % (code K)

**DISSIPATION FACTOR**

Class 1: max. 0.5 % (1 MHz)

Class 2: max. 2.5 % (1 kHz)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

**DIMENSIONS** in millimeters


Capacitors with 5.0 mm, 7.5 mm, 10 mm, or 12.5 mm lead spacing.  
Coating extension  $e$  valid for straight leads only.

**TECHNICAL DATA**

| CAPACITANCE<br>C (pF)             | CAPACITANCE<br>TOLERANCE<br>(%) | BODY<br>DIAMETER<br>$D_{max.}$ (mm) | BODY<br>THICKNESS<br>$T_{max.}$ (mm) | LEAD SPACING <sup>(1)</sup><br>F (mm) $\pm 1$ mm | PART NUMBER                               |
|-----------------------------------|---------------------------------|-------------------------------------|--------------------------------------|--------------------------------------------------|-------------------------------------------|
|                                   |                                 |                                     |                                      |                                                  | MISSING DIGITS SEE<br>ORDERING CODE BELOW |
| <b>U2J (N750)</b>                 |                                 |                                     |                                      |                                                  |                                           |
| 10                                | $\pm 10$                        | 7.5                                 | 5.0                                  | 5.0, 7.5, 10.0, or 12.5                          | VY2100K29U2JS6###                         |
| 15                                |                                 |                                     |                                      |                                                  | VY2150K29U2JS6###                         |
| 22                                |                                 |                                     |                                      |                                                  | VY2220K29U2JS6###                         |
| 33                                |                                 |                                     |                                      |                                                  | VY2330K29U2JS6###                         |
| 47                                |                                 |                                     |                                      |                                                  | VY2470K29U2JS6###                         |
| <b>Y5S (2C3)</b>                  |                                 |                                     |                                      |                                                  |                                           |
| 68                                | $\pm 10$                        | 7.5                                 | 5.0                                  | 5.0, 7.5, 10.0, or 12.5                          | VY2680K29Y5SS6###                         |
| 100                               |                                 |                                     |                                      |                                                  | VY2101K29Y5SS6###                         |
| 150                               |                                 |                                     |                                      |                                                  | VY2151K29Y5SS6###                         |
| 220                               |                                 |                                     |                                      |                                                  | VY2221K29Y5SS6###                         |
| 330                               |                                 |                                     |                                      |                                                  | VY2331K29Y5SS6###                         |
| 470                               |                                 |                                     |                                      |                                                  | VY2471K29Y5SS6###                         |
| <b>Y5U (2E3)</b>                  |                                 |                                     |                                      |                                                  |                                           |
| 680                               | $\pm 20$                        | 7.5                                 | 5.0                                  | 5.0, 7.5, 10.0, or 12.5                          | VY2681M29Y5US6###                         |
| 1000                              |                                 |                                     |                                      |                                                  | VY2102M29Y5US6###                         |
| 1500                              |                                 | 8.0                                 |                                      |                                                  | VY2152M31Y5US6###                         |
| 2200                              |                                 | 9.0                                 |                                      |                                                  | VY2222M35Y5US6###                         |
| 3300                              |                                 | 10.5                                |                                      |                                                  | VY2332M41Y5US6###                         |
| 3900                              |                                 | 11.0                                |                                      |                                                  | VY2392M43Y5US6###                         |
| 4700                              |                                 | 12.5                                |                                      | VY2472M49Y5US6###                                |                                           |
| 6800                              |                                 | 14.5                                |                                      | 7.5, 10.0, or 12.5                               | VY2682M59Y5US63##                         |
| 10 000                            |                                 | 16.0                                |                                      | VY2103M63Y5US63##                                |                                           |
| <b>Y5V (2F3) MINI SIZE SERIES</b> |                                 |                                     |                                      |                                                  |                                           |
| 1000                              | $\pm 20$                        | 7.5                                 | 5.0                                  | 5.0, 7.5, 10.0,<br>or 12.5                       | VY2102M29Y5VS6###                         |
| 1500                              |                                 | 7.5                                 |                                      |                                                  | VY2152M29Y5VS6###                         |
| 2200                              |                                 | 8.0                                 |                                      |                                                  | VY2222M31Y5VS6###                         |
| 3300                              |                                 | 9.0                                 |                                      |                                                  | VY2332M35Y5VS6###                         |
| 3900                              |                                 | 10.0                                |                                      |                                                  | VY2392M39Y5VS6###                         |
| 4700                              |                                 | 10.5                                |                                      |                                                  | VY2472M41Y5VS6###                         |
| 6800                              |                                 | 12.0                                |                                      |                                                  | VY2682M47Y5VS6###                         |
| 10 000                            |                                 | 15.0                                |                                      |                                                  | VY2103M59Y5VS6###                         |

**Note**

<sup>(1)</sup> Straight leads are available on request

| ORDERING CODE  |                                            |                   |                |                    |                         |                            |                                    |                                                     |                                         |                                            |
|----------------|--------------------------------------------|-------------------|----------------|--------------------|-------------------------|----------------------------|------------------------------------|-----------------------------------------------------|-----------------------------------------|--------------------------------------------|
| ###            | 15 <sup>th</sup> to 17 <sup>th</sup> digit |                   |                | Lead configuration |                         |                            | Available configurations see below |                                                     |                                         |                                            |
| <b>Example</b> | <b>VY2</b>                                 | <b>221</b>        | <b>K</b>       | <b>29</b>          | <b>Y5S</b>              | <b>S</b>                   | <b>6</b>                           | <b>U</b>                                            | <b>V</b>                                | <b>7</b>                                   |
|                | Series                                     | Capacitance value | Tolerance code | Size code          | Temperature coefficient | Rated voltage              | Lead wire diameter                 | Packaging / lead length                             | Lead style                              | Lead spacing                               |
|                |                                            |                   |                |                    |                         | S =<br>X1/Y2<br>300 V (AC) |                                    | 3 = bulk<br>T = tape<br>and reel<br>U =<br>ammopack | L =<br>straight<br>V = inline<br>kinked | 5 = 5.0<br>7 = 7.5<br>0 = 10.0<br>X = 12.5 |

**LEADSPACING 5.0 mm AND 7.5 mm**

| PACKAGING |                                  |                      |      |      |
|-----------|----------------------------------|----------------------|------|------|
| SIZE CODE | BODY DIAMETER<br>$D_{max.}$ (mm) | PACKAGING QUANTITIES |      |      |
|           |                                  | BULK                 | REEL | AMMO |
| 29 to 49  | 12.5                             | 1000                 | 1000 | 1000 |
| 59 to 63  | 16.0                             | 500                  | -    | -    |

**LEADSPACING 10.0 mm AND 12.5 mm**

| PACKAGING               |           |                                  |                      |      |      |
|-------------------------|-----------|----------------------------------|----------------------|------|------|
| CAPACITANCE VALUE       | SIZE CODE | BODY DIAMETER<br>$D_{max.}$ (mm) | PACKAGING QUANTITIES |      |      |
|                         |           |                                  | BULK                 | REEL | AMMO |
| 10 pF to 4700 pF        | 29 to 49  | 12.5                             | 1000                 | 500  | 750  |
| 6800 pF to 0.01 $\mu$ F | 59 to 63  | 16.0                             | 500                  | 500  | 750  |

**Note**

- The capacitors are supplied in bulk packaging (cardboard boxes), in tape on reel in ammopack

**STRAIGHT LEADS**




Fig. 1 - Kinked capacitors on tape, lead spacing 5.0 mm (0.2") and 7.5 mm (0.3")



Fig. 2 - Inline kink (V) leaded capacitors on tape, lead spacing 10 mm (0.40")

| DIMENSION OF TAPE             |                                              | DIMENSIONS (mm)     |                     |                      |
|-------------------------------|----------------------------------------------|---------------------|---------------------|----------------------|
| SYMBOL                        | PARAMETER                                    | FIG. 1 (5 mm)       | FIG. 1 (7.5 mm)     | FIG. 2 (10 mm)       |
| D <sup>(1)</sup>              | Body diameter                                | 11.0 max.           | 14.0 max.           | 16.0 max.            |
| d                             | Lead diameter                                | 0.6 ± 0.05          | 0.6 ± 0.05          | 0.6 ± 0.05           |
| P                             | Pitch of component                           | 12.7 ± 1            | 15.0 ± 1            | 25.4 ± 1             |
| P <sub>0</sub> <sup>(2)</sup> | Pitch of sprocket hole                       | 12.7 ± 0.3          | 15.0 ± 0.3          | 12.7 ± 0.3           |
| P <sub>1</sub> <sup>(3)</sup> | Distance, hole center to lead                | 3.85 ± 0.7          | 3.75 ± 0.7          | 7.7 ± 1.0            |
| P <sub>2</sub> <sup>(3)</sup> | Distance, hole to center of component        | 6.35 ± 1.3          | 7.5 ± 1.5           | 12.7 ± 1.5           |
| F                             | Lead spacing                                 | 5.0 (+ 0.6 / - 0.4) | 7.5 (+ 0.6 / - 0.4) | 10.0 (+ 0.6 / - 0.4) |
| Δh                            | Average deviation across tape                | ± 1.0 max.          | ± 1.0 max.          | ± 1.0 max.           |
| ΔP                            | Average deviation in direction of reeling    | ± 1.0 max.          | ± 1.0 max.          | ± 1.0 max.           |
| W                             | Carrier tape width                           | 18.0 + 1 / - 0.5    | 18.0 + 1 / - 0.5    | 18.0 + 1 / - 0.5     |
| W <sub>0</sub>                | Hold-down tape width                         | 5.0 min.            | 5.0 min.            | 5.0 min.             |
| W <sub>1</sub>                | Position of sprocket hole                    | 9.0 + 0.75 / - 0.5  | 9.0 + 0.75 / - 0.5  | 9.0 + 0.75 / - 0.5   |
| W <sub>2</sub>                | Distance of hold-down tape                   | 3.0 max.            | 3.0 max.            | 3.0 max.             |
| H <sub>1</sub>                | Maximum component height                     | 32                  | 40                  | 40                   |
| H <sub>0</sub>                | Height to seating plane (for kinked leads)   | 16.0 ± 0.5          | 16.0 ± 0.5          | 16.0 ± 0.5           |
| H <sub>0</sub>                | Height to seating plane (for straight leads) | 20.0 ± 0.5          | 20.0 ± 0.5          | 20.0 ± 0.5           |
| L                             | Length of cut leads                          | 11.0 max.           | 11.0 max.           | 11.0 max.            |
| L <sub>1</sub>                | Length of lead protrusion                    | 1.0 max.            | 1.0 max.            | 1.0 max.             |
| D <sub>0</sub>                | Diameter of sprocket hole                    | 4.0 ± 0.2           | 4.0 ± 0.2           | 4.0 ± 0.2            |
| t                             | Total tape thickness                         | 0.9 max.            | 0.9 max.            | 0.9 max.             |
| t <sub>1</sub>                | Maximum thickness of tape and wires          | 1.5 max.            | 1.5 max.            | 1.5 max.             |

**Notes**

- (1) See "Technical Data" table
- (2) Cumulative pitch error: ± 1 mm/20 pitches
- (3) Obliquity maximum 3°



REEL AND TAPE DATA in millimeters



| APPROVALS                                                                                                                                                         |                |                |                     |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|---------------------|--|
| IEC 60384-14.4 - Safety tests<br>This approval together with CB test certificate substitutes all national approvals.                                              |                |                |                     |  |
| <b>CB Certificate</b>                                                                                                                                             |                |                |                     |  |
| Y2-capacitor: CB test certificate:                                                                                                                                | US-26163-UL    | 10 pF to 10 nF | 300 V <sub>AC</sub> |  |
| X1-capacitor: CB test certificate:                                                                                                                                | US-26163-UL    | 10 pF to 10 nF | 440 V <sub>AC</sub> |  |
| <b>VDE</b>                                                                                                                                                        |                |                |                     |  |
| Y2-capacitor: VDE marks approval:                                                                                                                                 | 40009669       | 10 pF to 10 nF | 300 V <sub>AC</sub> |  |
| X1-capacitor: VDE marks approval:                                                                                                                                 | 40009669       | 10 pF to 10 nF | 440 V <sub>AC</sub> |  |
| DIN EN 60384-14 VDE 0565-1-1:2006-04 - Safety tests                                                                                                               |                |                |                     |  |
| <b>Underwriters Laboratories Inc. / Canadian Standards Association</b>                                                                                            |                |                |                     |  |
| Y2-capacitor: UL-test certificate:                                                                                                                                | E183844        | 10 pF to 10 nF | 300 V <sub>AC</sub> |  |
| X1-capacitor: UL-test certificate:                                                                                                                                | E183844        | 10 pF to 10 nF | 440 V <sub>AC</sub> |  |
| UL 60384-14.1, CSA E60384-1:03 2 <sup>nd</sup> edition, CSA E60384-14:09 2 <sup>nd</sup> edition<br>Across-the-line, antenna-coupling, and line-by-pass component |                |                |                     |  |
| <b>CQC</b>                                                                                                                                                        |                |                |                     |  |
| Y2-capacitor: CQC test certificate:                                                                                                                               | CQC05001012316 | 10 pF to 10 nF | 300 V <sub>AC</sub> |  |
| X1-capacitor: CQC test certificate:                                                                                                                               | CQC05001012316 | 10 pF to 10 nF | 440 V <sub>AC</sub> |  |

| MARKING             |              |                                                                                                                                                                        |
|---------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sample<br>(2 sides) | <p>Front</p> | <p>Back</p>                                                                                                                                                            |
|                     |              |                                                                                                                                                                        |
|                     |              | PN: VY2331K29Y5SS6UV7    Lot1: 14Z549306    DC1: 0601<br>QTY: 1000    Lot2:    DC2:<br>PO:    Batch: 200601CN<br>SO:    Region: 9520    SL: 0010<br>Ser.No: 0601H72383 |
|                     |              | <br>2/5                                                                                                                                                                |

| PERFORMANCE                      |                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                 |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST                             | TEST CONDITION                                                                                                                                                                                                                                                                                                                                                                                | TEST LIMITS                                                                                                                                                                                     |
| Visual and mechanical inspection | Optical inspection, dimensions measured with caliper                                                                                                                                                                                                                                                                                                                                          | No visible damage, marking legible                                                                                                                                                              |
| Capacitance (C)                  | 25 °C ± 3 °C, relative humidity (RH) ≤ 75 %, 1.0 V <sub>RMS</sub> ± 0.2 V <sub>RMS</sub> at 1 kHz for Y5U and Y5S, and 1 MHz for U2J                                                                                                                                                                                                                                                          | Capacitance within specified tolerance                                                                                                                                                          |
| Dissipation factor (DF)          |                                                                                                                                                                                                                                                                                                                                                                                               | DF ≤ 0.3 % for U2J and DF ≤ 2.5 % for Y5S and Y5U                                                                                                                                               |
| Insulation resistance (IR)       | Measured within 60 s ± 5 s after charging at 500 V <sub>DC</sub>                                                                                                                                                                                                                                                                                                                              | 10 000 MΩ min.                                                                                                                                                                                  |
| Dielectric strength              | 2600 V <sub>AC</sub> at 50 Hz / 60 Hz for 1 min, 50 mA max.                                                                                                                                                                                                                                                                                                                                   | No failure                                                                                                                                                                                      |
| Temperature characteristic       | RH ≤ 75 %, 1.0 V <sub>RMS</sub> ± 0.2 V <sub>RMS</sub> at 1 kHz for Y5U and Y5S, and 1 MHz for U2J                                                                                                                                                                                                                                                                                            | U2J: -750 ppm ± 120 ppm<br>Y5S: ± 22 %<br>Y5U: +22 % / -56 %                                                                                                                                    |
| Impulse voltage                  | 3 pulses of 5 kV                                                                                                                                                                                                                                                                                                                                                                              | No failure                                                                                                                                                                                      |
| Life test                        | 1000 h at 125 °C ± 2 °C, 550 V <sub>AC</sub> /50 Hz; once every hour 1000 V <sub>AC</sub> for 0.1 s                                                                                                                                                                                                                                                                                           | External appearance: no visible damage<br>ΔC/C ≤ ± 15 %<br>DF ≤ 0.5 % for U2J and ≤ 5 % for Y5S and Y5U<br>IR ≥ 3000 MΩ<br>Dielectric strength: no failure                                      |
| Humidity test                    | 500 h at 440 V <sub>AC</sub> , 50 Hz and 500 h unloaded 40 °C, RH = 90 % to 95 %                                                                                                                                                                                                                                                                                                              | External appearance: no visible damage<br>ΔC/C ≤ ± 10 % for U2J and ≤ ± 15 % for Y5S and Y5U<br>DF ≤ 0.5 % for U2J and ≤ 5 % for Y5S and Y5U<br>IR ≥ 3000 MΩ<br>Dielectric strength: no failure |
| Robustness of termination        | Pull test: 0.5 kg tensile weight in radial direction for 10 s ± 1 s<br>Bending strength: capacitor body rotated by 90° in both directions                                                                                                                                                                                                                                                     | No damage to capacitor body and lead wire                                                                                                                                                       |
| Soldering effect                 | Immersion of lead wires into 260 °C ± 5 °C solder for 10 s ± 2 s; min. distance from body: 1.5 mm<br>Hand soldering at 400 °C ± 10 °C for 3 s to 4 s; min. distance from body: 1.5 mm                                                                                                                                                                                                         | External appearance: no visible damage<br>ΔC/C ≤ ± 5 % for U2J and ≤ ± 10 % for Y5S and Y5U<br>Dielectric strength: no failure                                                                  |
| Vibration test                   | <p>Resin (adhesive)</p> <p>Solder the capacitor onto test jig (glass epoxy body) and use resin (adhesive) to stick the body to the test jig. The capacitor must be soldered firmly to the supporting lead wire. Vibration change from 10 Hz to 2000 Hz and back to 10 Hz; Total amplitude: 1.5 mm; Acceleration: 100 m/s<sup>2</sup>; Sweep rate: 1 oct/min, each axis 2 h (6 h in total)</p> | External appearance: no visible damage<br>Capacitance within specified tolerance<br>DF ≤ 0.3 % for U2J and ≤ 2.5 % for Y5S and Y5U<br>IR ≥ 10 000 GΩ                                            |



**LEAKAGE CURRENT VS. VOLTAGE (Typical)**



**Note**

- The capacitors meet the essential requirements of EIA 198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 °C ± 3 °C, at normal atmospheric conditions

| <b>RELATED DOCUMENTS</b> |                                                                        |
|--------------------------|------------------------------------------------------------------------|
| General Information      | <a href="http://www.vishay.com/doc?28536">www.vishay.com/doc?28536</a> |
| CB Test Certificate      | <a href="http://www.vishay.com/doc?22254">www.vishay.com/doc?22254</a> |
| VDE Marks Approval       | <a href="http://www.vishay.com/doc?22256">www.vishay.com/doc?22256</a> |
| UL Test Certificate      | <a href="http://www.vishay.com/doc?22253">www.vishay.com/doc?22253</a> |
| CQC Test Certificate     | <a href="http://www.vishay.com/doc?22255">www.vishay.com/doc?22255</a> |
| LTspice® Models          | <a href="http://www.vishay.com/doc?28568">www.vishay.com/doc?28568</a> |

| <b>SAMPLE KITS</b>                 |                                                                        |
|------------------------------------|------------------------------------------------------------------------|
| Part Number (VY2 Sample Kit)       | VY21-KIT-HF                                                            |
| Link (VY2 Sample Kit)              | <a href="http://www.vishay.com/doc?28554">www.vishay.com/doc?28554</a> |
| Part Number (VY2...Y5V Sample Kit) | VY2-KIT-MS                                                             |
| Link (VY2...Y5V Sample Kit)        | <a href="http://www.vishay.com/doc?28562">www.vishay.com/doc?28562</a> |



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- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
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- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.