"CGS" ALUMINUM ELECTROLYTIC CAPACITORS

EXTREME APPLICATON

HIGHLIGHTS

Capacitance –50-500,000µF
Voltage –15 to 500 WVDc
-10%, + 20% Tolerance and
-10%, + 50%
Temperature Range -40ºC to +85ºC
Case Sizes – 1 x 2-1/8 to 3 x 8.625 inches
Grade – Computer Standard Application
Key Features – Safety Vent Construction
Wide Variety of Case Sizes
Choice of Terminals
Long Life/High Ripple
Low ESR/Low Leakage Current
Rapid Discharge / High Current

APPLICATION

U.P.S Systems
Inverters/P.C.U.s.
Motor Special Controls
Computers
Power Filtering
Power Supplies
X-Ray Equipments
Welding Application
Energy Storage Applications
Photo Flash
Multiplier Circuits
Strobe Applications
Telecommunication
Broadcast Equipment

BETTER PERFORMANCE AND RIPPLE CAPACITY

The CGS capacitor is a computer grade standard application aluminum electrolytic capacitor in a rugged aluminum can with a choice of mounting and terminal configurations. The computer grade capacitors in an electrical performance end high-ripple capability.

With capacitances up to 500,000µF and ripple capability up to 50 amperes RMS at 85ºC, the CGS handles computer grade application requirements.

Included in this bulletin is a complete application guide, typical performance curves, and full performance characteristics. For applications requiring ratings different from these, contact DuraCap International Incorporated, the web site is http://www.duracap.com.

APPLICATION GUIDE

1.1 RIPPLE CURRENT

The maximum ripple current recommended for CGS capacitors is shown in the Standard Ratings Table. Ripple current ratings are based on 120 Hz ripple and 85°C circulating air. Maximum ripple current may be adjusted for operation at a frequency other than 120 Hz and a temperature other than 85°C by multiplying by the factors of Tables 1 and 2 below.

TABLE 1 Ripple Current Frequency Multipliers

Rated WVDC	Ripple Multipliers at				
	60 Hz	120 Hz	400 Hz	1000 Hz	2500 Hz
3 to 50	0.8	1.0	1.05	1.10	1.14
51 - 150	0.8	1.0	1.08	1.13	1.16
151 & up	0.8	1.0	1.15	1.21	1.25

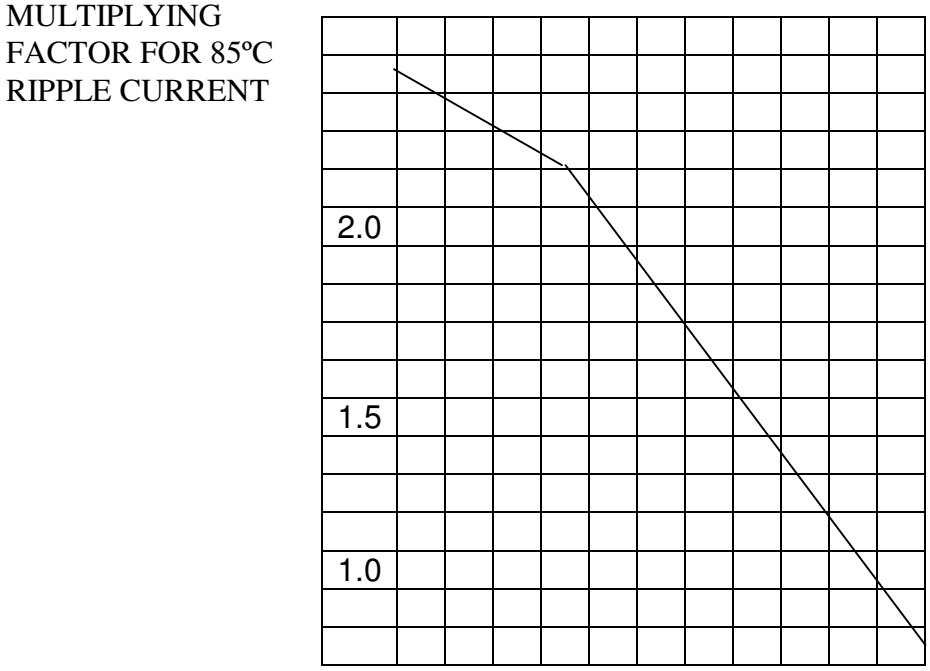
TABLE 2

Ripple Current Temperature Multipliers

Ambient Temperature	Ripple Multiplier
85°C	1.0
75°C	1.3
65°C	1.6
55°C	1.9
45°C	2.1

Multiplying Factors for temperatures not listed in Table 2 may be obtained from the Ripple vs. Temperature Graph below.

RIPPLE VS.TEMPERATURE



Ripple current capability depends upon case area and ESR because ripple current dissipates power in the ESR and case area determines the core temperature rise. A different capacitance from that listed in Standard Ratings Table will have a different ESR and, therefore, a different ripple current rating. The ripple capability is proportional to square root of capacitance for the same WVDC and case size.

1.2 CASE POTENTIAL

With standard CGS construction all electrical connections are through the terminals and the case is floating. The insulation resistance between the case and terminals is indeterminate because electrolyte may contact the case. The case may be connected to the same potential as the negative terminal but other possible connections should be avoided by utilizing an insulating sleeve.

1.3 OPERATING LIFE

CGS capacitors are expected to provide a useful operating life of approximately 10 years when subjected to normal computer power supply circuitry, duty cycle and ambient temperature within the application conditions of this bulletin. Longer operating life can be expected when operating voltage; ripple current and ambient temperature are reduced.

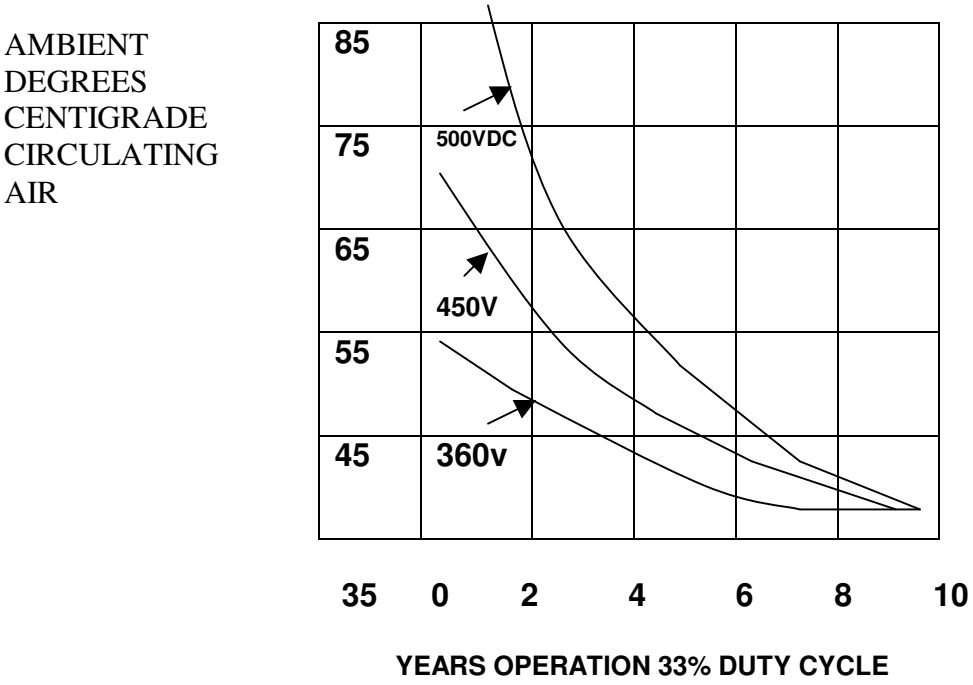
Typically the capacitance will remain stable through life while the ESR will increase with time - more rapidly toward the end of life. The amount of ESR increase, which can be tolerated in a circuit, determines the useful life. The DCL decreases in early life and remains at low value unless operating voltage is applied infrequently.

1. APPLICATION GUIDE

A typical performance curve showing normal expected life as a function of ambient temperature is provided. The curve is derived for units operating in circulating air and with the full ripple currents of the Standard Ratings Table.

RIPPLE LIFE VS. TEMPERATURE

Ripple Current as listed in Standard Ratings



1.4. SHELF LIFE

CGS capacitors can generally withstand storage in excess of three years at less than 40°C without deterioration. Capacitors stored for long periods, especially at high temperature, may show significantly increased DCL. The DCL can usually be decreased to original limits by application of voltage increasing in steps to working voltage with the d.c. Supply power limited to not exceed the rated ripple power. [$(I^2 R)$ x (ESR max).]

1.5. REVERSE VOLTAGE

A reverse voltage of up to 1.5 volts may be applied continuously to polarized CGS capacitors without significantly affecting performance.

1.6. NONPOLAR/SEMI POLAR

Non-polar capacitors are available for most of the CGS working voltage ratings. The maximum capacitance available in a non-polar unit is less than for a polarized unit. To determine the maximum capacitance available multiply the capacitance listed in the Standard Rating Table by the appropriate multiplier of Table 4 below.

TABLE 4 Maximum Capacitance for Non-polar Capacitors

Rated WVdc	Multiply Polarized Maximum Capacitance by
5	.50
10	.47
15	.48
20	.46
25	.45
30	.44
40	.43
50-60	.42
75-250	.41
300-500	.42

The ESR for a non-polarized capacitor will be less than for the same capacitance rating in a polarized unit. The ESR for the maximum non-polarized capacitance in a particular case size will be greater than the ESR of the maximum polar capacitance in the same case size because the non-polar capacitance is less.

1.7. SOLVENTS

CGS capacitors have aluminum cases, elastomer end seals, ink identification marking and may have PVC sleeves. These materials are subject to chemical attack from some cleaning solvents. Solvent residues on the capacitors after cleaning may attack the aluminum cases. Solvent penetrating the capacitor end seal may cause internal corrosion resulting in short life.

Cleaning methods for assemblies including CGS capacitors should be developed with the solvent vendor. Alternately, the capacitors may be mounted after cleaning the assemblies. Alcohol or water-detergent cleaning is not usually harmful but halogenated cleaning solvents are not recommended and should be avoided.

1.8. MOUNTING

It is recommended that these Capacitors with silicone rubber safety vents be mounted with terminals up. Other mounting orientations may affect useful life or DCL performance due to mobility of the electrolyte.

If horizontal mounting necessary, vent plug should be at 9 o’clock or 12 o’clock position.

1.9. SAFETY VENT

All CGS capacitors are equipped with safety-vents designed to rupture and release high internal gas pressure generated by overheated electrolyte if reverse voltage is applied to the capacitor or excessive voltage or current overload occurs. 1-inch diameter capacitors are provided with a pressure-sensitive slit type safety-vent in the sidewall of the container. All others are equipped with a silicone rubber safety-vent structure located in the molded cover. Capacitors, which have vented should be removed from equipment and discarded. All remaining capacitors should be tested for possible deterioration.

2. PERFORMANCE CHARACTERISTICS

2.1. POLARITY - DC or NP

CGS capacitors are polarized (DC) or non-polarized (NP). The reverse voltage capability of polarized capacitors is 1.5 volts.

2.2. TEMPERATURE RANGE - 40°C to +85°C

CGS capacitors have an operating temperature range of - 40°C to + 85 °C. Capacitors are capable of withstanding storage temperatures from -55°C to +85°C.

2.3. CAPACITANCE TOLERANCE:

F = -0% +30%; T = -10% +50%; U = -10% +75% AND X = -10% +20%

2.4. WORKING VOLTAGE - 15 to 500 Volts

Working voltage, WVdc, is the maximum continuous DC voltage, which may be applied at the rated temperature. Polarized and non-polarized capacitors are available from 3 to 500 WVdc.

2.5. SURGE VOLTAGE - 5 to 75 Volts Above WVdc

The DC surge voltage is the maximum voltage to which the capacitor can be subjected under any conditions including transients and peak ripple at the highest line voltage. Surge voltages are shown in the Standard Ratings Table.

Surge voltage capability may be tested as follows:

Connect the capacitor in series with a current limiting resistor and apply the rated surge voltage at room temperature for a period of 30 seconds then discharge the capacitor through the resistor. This test shall be repeated at 10-minute intervals for a period of 24 hours. The leakage current measured before the surge test and four hours after completion must not have increased but need not be less than 100 microamperes. There should be no leakage of electrolyte from the seal or distortion of the container.

a. For capacitors up to 2500 µF the current-limiting resistor is 1000 ohms.

b. For capacitors greater than 2500 µF the current limiting resistor value is determined by the following equation:

$$R = \frac{2.5 * 10^{6}}{C}$$

Where:

C is in microfarads

R is in ohms

Example: for a 50,000 µF capacitor,

R = 2,500,000/50,000 = 50 *ohms*

One failure in 36 samples tested shall be permitted.

2.6. EQUIVALENT SERIES RESISTANCE

The equivalent series resistance (ESR) is a single resistance representing all the ohmic circuit losses in the capacitor. When tested per Paragraph 2.8, the ESR shall not exceed the limits of the Standard Ratings Table.

2.7. LEAKAGE CURRENT - (DCL) MAX 6 MA.

Leakage current (DCL) is the DC current flowing through the capacitor. During application of voltage to new capacitors the DCL decreases and will stabilize in from 1 to 10 days to a small fraction of the value measured after five minutes electrification.

DCL shall be tested under the conditions of Paragraph 2.8 as follows:

Pre-conditioning. Capacitors shall be preconditioned for DCL current measured by applying rated working voltage for 30 minutes minimum at least 24 hours and not more than 48 hours before test.

Measurement. Sufficient DC voltage shall be applied with a steady, regulated source of power across a series combination which includes the capacitor being tested, a millimeter and a current limiting resistor of a value which permits rated DC voltage to appear across the capacitor within one minute. The maximum DCL current after five minutes electrification time at rated working voltage and

25ºC+ -5ºC shall not exceed the value as determined from the equation:

$$I = .006\sqrt{CV}$$

Where I is the DCL in milliamperes, C is the measured value of capacitance in µF, V is the rated DC voltage.

In no case, however, shall the DC leakage current exceed six milliamperes at +25ºC.

2.8. ELECTRICAL TEST CONDITIONS

The standard test frequency for AC measurements is 120 Hz. The AC test signal amplitude shall be 1.0 V rms or less and DC voltage bias is not required. Standard test conditions are 25ºC, 40% maximum relative humidity and test instruments shall have an accuracy of +/- 2% or better.

2.9. LOW TEMPERATURE CHARACTERISTICS

The capacitance of the capacitor at reduced temperature and at 120 Hz shall not be less than the following percentage of nominal rated room temperature

(+25ºC) capacity:

Rated DC Voltage	Percent of Nominal Rated Capacitance		
	-20ºC	-30ºC	-40ºC
15 - 100	80	65	35
101 and up	85	75	45

2.10. Q.A. LIFE TEST

Capacitors shall be capable of operating at +85°C with rated DC working voltage applied for 1000 hours in an air-circulating oven. The capacitors shall be separated by at least one inch. Air circulation shall be sufficient to prevent the temperature within 6" (152.4mm) of any capacitor from departing more than

+0/-3°C from the ambient temperature of the chamber. Capacitors shall not be exposed to direct radiation from the heating elements.

On completion of the life test, the capacitors shall be returned to standard test conditions and shall meet the following requirements. Not more than one defective in a sample of twelve capacitors shall be permitted.

a. The capacitance shall not have decreased more than 10% nor increased more than 20% from the initial measured value.

b. The equivalent series resistance (ESR) shall not exceed 175% of the initial measured value.

c. The DC leakage current, when measured per Paragraph 2.6 shall not exceed the initial requirement.

d. There shall be no evidence of electrolyte leakage or deformation of the container.

Units submitted to life test shall not be subjected to vibration or container seal tests.

2.11. SHELF LIFE TEST - 100 Hours at + 85°C

Capacitors shall be subjected to a maximum working temperature of 85°C for 100 hours without application of voltage. The capacitors shall then be returned to 25°C for at least 24 hours.

There shall be no evidence of electrolyte leakage or deformation of the container and capacitance, ESR and DC leakage current shall meet specification requirements.

2.12. TERMINAL STRENGTH

Solder lug terminals will withstand 10 inch-pounds torque without loosening from the aluminum inserts. Screw insert terminals will withstand 30 inch-pounds torque on American Standard 10/32 screws when the screws are engaged .188 inches or more. Screw length should be selected to provide .188 inches or more thread penetration depth. Molded capacitor tops including terminals will withstand 20 inch-pounds torque without turning in the cans.

2.13. SLEEVING INSULATION – 100MΩ, 2000 Vdc

Insulating sleeving when supplied shall have minimum insulation resistance of 100 M ohm and be capable of withstanding 2000 Volts DC. During test, the capacitor sleeve shall be wrapped tightly with two turns of aluminum foil and three turns of AWG 18 bare copper wire. The foil shall be no closer than ¼ inch from either end of the capacitor and

all terminals shall be shorted together.

2.14. VIBRATION - Low Frequency

CGS capacitors can withstand six hours of vibration over a frequency range of 10 to 55 cps and return, traversed within a period of one minute with maximum amplitude of vibration of .03" (total excursion .06"). The capacitors shall be mounted by an approved clamp.

At some period during the last hour of the test, each capacitor should be connected to a bridge and observed for a continuous period of three minutes. It should be possible to maintain a bridge balance with no evidence of intermittent contact during the test.

2.15. SEAL - BUBBLE TEST

Following the vibration test the capacitors shall be capable of passing container seal test consisting of two temperature cycles in circulating air as follows:

a. Place capacitors in oven maintained at 85°C +/- 3°C and hold at that temperature for 15 minutes.

b. Allow capacitors to cool to room temperature.

c. Place capacitors in a cold chamber maintained at -20°C +/- 5°C an hold at that temperature for 15 minutes.

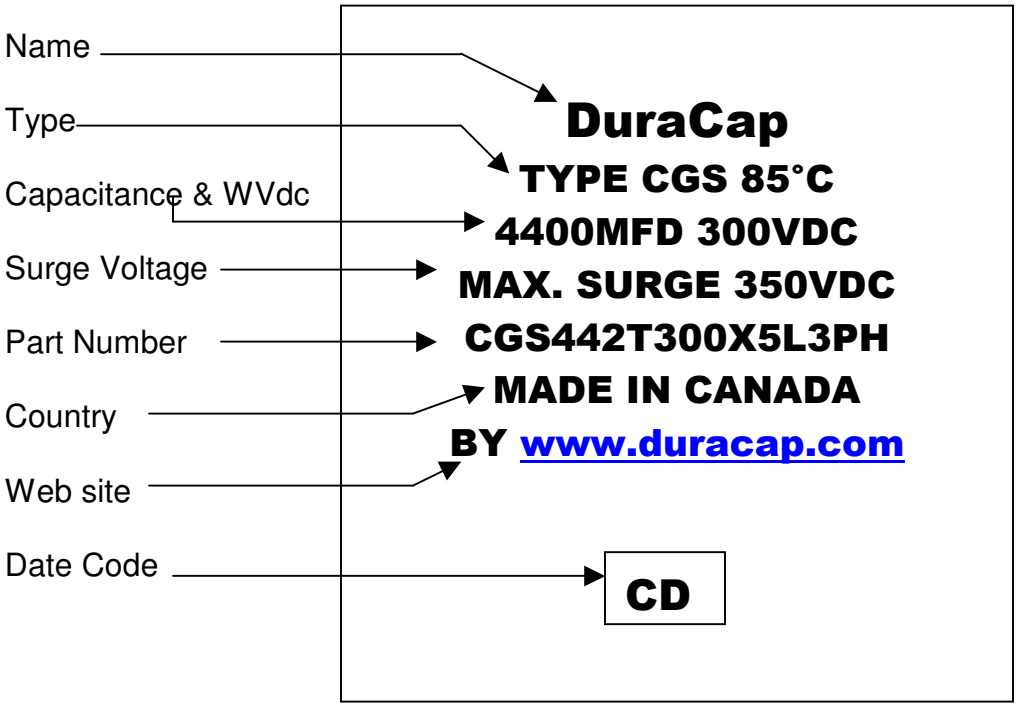
d. Allow capacitors to return to room temperature.

Place capacitors in water maintained at 85°C to 95°C for a period of five minutes. During this immersion there shall be no chain of repetitive bubbling from any part of the capacitor.

Capacitors tested for vibration and seal shall not be subjected to life test.

2.16. MARKING

CGS capacitors are legibly marked as shown in the typical example below:


Name
Type
Capacitance & WVdc
Surge Voltage
Part Number
Country
Web site
Date Code
DuraCap
TYPE CGS 85°C
4400MFD 300VDC
MAX. SURGE 350VDC
CGS442T300X5L3PH
MADE IN CANADA
BY www.duracap.com
CD

APPLICATION NOTE

RECONDITIONING ALUMINUM ELECTROLYTIC CAPACITORS

The DC leakage current of Aluminum Electrolytic Capacitors at rated voltage may increase after extended storage, particularly at elevated temperatures.

To restore the leakage current to the minimal value as supplied by DuraCap International Inc, proceed as follows:

In an ambient temperature of 25°C, apply 110% of the rated DC working voltage through a current limiting series resistor to each capacitor separately.

Caution: Absolutely insure correct polarity of your power supply connections (i.e. + terminal of the power supply, through resistor, to the + terminal of the capacitor)

Rated WVDC	Current Limiting Resistance (10-Watt)
15-100	1000 Ohms
101-250	10000 Ohms
251-450	25000 Ohms

Note: Pre-heating the capacitor before reconditioning to as high as 85°C is recommended if capacitors have been stored at low temperature.

- Reconditioning should take 2 or 3 hours. When the voltage across each capacitor is about 5% above the rated working voltage, they may be considered reconditioned. (Discard parts that will not recondition after several hours)

- Proceed with caution - shock hazard is directly proportional to applied voltage above 75 volts - high energy levels are present.
- Turn off power and short circuit the output terminals of the power supply (also discard parts that show a ruptured pressure vent or any evidence of liquid leakage)

Note: Use a voltmeter to verify complete discharge of each capacitor before removing parts from the reconditioning circuit.

- Since some heat may be generated internally during reconditioning, the capacitors should be allowed to stabilize to 25°C for at least 8 hours before testing DC leakage current as outlined in the technical information bulletin.

Your capacitors should now meet original specifications.

WARNING!!

DO NOT MISAPPLY ELECTROLYTIC CAPACITORS

1.0 MISAPPLICATION FORMS

The more common types of misapplication that result in failures are:

1.1 Reverse voltage in excess of specified limits.

1.2 Ripple current or voltage above specification.

1.3 Application voltages beyond surge voltage specified.

1.4 Temperature exposures beyond specified limits.

2.0 PERSONAL SAFETY

2.1 Electrical misapplication of electrolytic capacitors may be hazardous. Personal injury or property damage may result from explosion of a capacitor or from the expulsion of electrolyte due to mechanical disruption of a capacitor. In case of injury or skin or eye exposure to electrolyte, contact a physician immediately.

2.2 Don't dispose of capacitors in fire, explosion may result.

Before using capacitors in any application, please read this Technical Information Bulletin carefully familiarizing yourself thoroughly with the information contained herein. Special care should be taken to insure that the capacitors are proper for your application and that warnings and instructions for use are followed.

> DO CHECK the intended application and operating conditions of the capacitor before use in any product to insure the capacitor is proper for your application.

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