SERVICE LIFE of HYBRID CAPACITORS

All Hybrid Capacitors use Tantalum Pentoxide anodes and Ruthenium Oxide cathodes with wet electrolyte. This design has been proven in over ten years of field use and numerous customer application qualification tests for use in Military and Aerospace Systems (see also http://www.evanscap.com/MTBF.html).
ALL Hybrid Capacitors have unlimited cycle life.

THQ, THS, TDD, Hybrid Capacitor specified life is >2,000 Hrs at 85˚C and Rated Voltage or >2,000 hrs at 125˚C and 60% of rated voltage.

Testing and analysis provides for much greater life at de-rated operating voltage and temperature.
Voltage and Temperature Life Factors

De-rated operating voltage (Vworking) provides the first life increase factor.

Vworking/Vrated provides the voltage de-rate increase in life:
y= 171.27e-4.9277x

where x = Vw/ Vr and y is the life increase factor. This is equal to approx 2X life for each 10% de-rate in voltage.
As example: THQ3100572 at 85C and 80% Vr (80Vw) would have life of approx 8,000 hrs (2,000 X 2 X 2)

de-rated operating temperature (Tworking) provides an additional life increase factor:
Tworking/Trated (Twprovides the temperature de-rate increase in life:

y = 188.12e-0.0605x

where x = Tw/Tr and y is the life increase factor. This is equal to approx 2X life for each 10˚C decrease in temperature.
Example THQ3100572 operating at 100V and 65˚C would have a life of approx 8,000 hrs (2,000 X 2 X 2)

WHERE BOTH VOLTAGE AND TEMPERATURE DE-RATES APPLY, THE FACTORS ARE COMBINED AS:
Minimum Predicted life (hours) = 2000 X (Factor A) X (Factor B)

Example: THQ3100572 operating at 80Vw and 65˚CTw would have life of:

2,000 X (2 X 2) X (2 X 2) = 32,000 hrs.

Additional analysis regarding life calculations can be found here:
http://www.evanscap.com/pdf/Determination_of_Capacitor_Life_as_a_Function_of_Operating_Voltage_and_Temperature.pdf.

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y = 188.12e-0.0605x

In actual on-wing operational performance, we have field data from the Arrowhead system in the Apache Helicopter.
Accumulated hours in service on the Arrowhead system has now exceeded 1,000,000 hrs. There are multiple quantities of two different Hybrid Capacitors in that system: THQ3125332 (125V 3,300µF) and THQ3050243 (50V 24,000µF) which are packaged as modules. The accumulated 1,000,000 flight hours represents >20,000,000 capacitor hours of service, without any failures.

The THS3125422 (125V 4,200µF) has been produced in significant quantity for a phased array radar program. Our customer for this system, Northrop Grumman Baltimore, provided us with some basic information following their qualification testing of the capacitors. The tests were under accelerated conditions, both pulsing and static, for life testing of the capacitors. The tests were ended without a single capacitor failure, resulting in a greater than 5 million hour MTBF assessment of capacitor life. Subsequent fielding of many systems totaling thousands of capacitors has provided data of excellent system and capacitor reliability.

Although the actual total in-service hours for all Hybrid Capacitors is unknown, the total in-service MTBF can be estimated. To estimate the total fleet MTBF, we use 180,000 as the number hybrid capacitor units. This is the number delivered between 2005 and 2010. We use this period as we would assume that virtually all these units be in service. At only 100 hours per capacitor this would provide 18 million capacitor hours. At 1000 hours per capacitor, this would provide 180 million capacitor hours. We would predict that the actual number is between these points. The incidence of reported failure is so small, as to be negligible. Virtually all failure analysis determined failures were due to improper mounting, lead attachment, or system design - usually found in qualification testing.