Vincotech

EDLC as Backup Supply for A1080 & A1035-D

**A description using EDLCs as Backup Supply
for Tyco Electronics' GPS modules
A1080-A, A1035-D**

Application Note

**Version 1.1
Hardware Revisions 01, 02 and 03 (A1080)
Hardware Revisions 01 and 02 (A1035-D)**

Revision History

Rev.	Date	Description
1.0	07-06-07	Initial draft
1.1	08-21-08	New style; moved to Vincotech
	mm-dd-yy	

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1 Introduction

This document aims to highlight some consideration that should be taken into account when using electrochemical double layer capacitors (EDLCs, often also referred to as Goldcaps or Supercaps) for the backup supply of the A1080 and A1035-D GPS receiver and presents an example calculation for the maximum backup time. Although mainly material from Panasonic (http://www.panasonic.com/industrial/components/capacitive/cap_gold.htm) is used as reference source, the information applies to all EDLCs respectively. Please do not interpret this document as a suggestion to use only Panasonic devices, the reason for their prominent position is solely due to the fact, that Panasonic provides by far the most extensive information on their web pages. When choosing the appropriate EDLC other criteria like price, size and availability on the local market may apply.

2 Considerations using EDLCs as Backup Supply

The basic principle of EDLCs can be found in many different devices for quite different applications. [1], [2] They are used as high power devices for electric cars and as tiny little backup power supply. Obviously we concentrate on the latter.

2.1 Size

Basically the physical size is directly related to the capacity of the device. As a rule of thumb one can say that a bigger EDLC will lead to longer backup times. However, the same nominal capacitance might be available in different package variants (eg. shape, SMD vs. leaded).

2.2 Component Variation

The capacitance of an EDLC is subject to variations and usually specified as a nominal value in conjunction with tolerance information. Eg. the capacitance of the EECF5R5H105 [6] (nominal 1.0F) can vary between 0.8F and 1.8F. If maximum backup time is critical, always consider the lowest value for the calculations.

2.3 Temperature

Temperature range seems to be an issue with EDLCs, eg. Panasonic specifies the range from -25°C to +85°C as "wide temperature range". [2] Usually devices are specified only up +60°C or +70°C. [5] Please check carefully the datasheet of the device chosen. Furthermore the actual temperature the EDLC is exposed to has a significant influence on the life span of the device. [4]

2.4 Moisture

The impact of moisture is twofold. Firstly increasing moisture leads to higher leakage currents inside the EDLC as well as in the whole circuit, thus shortening the usable backup time instantly. Secondly permanent moisture (eg. tropical atmosphere) will degrade the overall life span of the device. [3], [4]

2.5 Processing

EDLCs are very sensitive to the manufacturing process. Special care should be taken not to overheat them during assembly. [4]

2.6 Life Span

The usable life span of an EDLC is limited. Its capacitance will decrease and its internal resistance will increase over time. The deterioration process is largely influenced by ambient conditions, applied voltages and currents involved, but will definitely take place and cannot be avoided. In consequence thereof the maximum backup time will decrease over time. Please consider this when designing the product. [4]

3 Example

The example calculation is based on the formula given in [4] on page 18:

$$t = C \cdot \frac{V_0 - i \cdot R - V_1}{i + i_l} = 0.8 \cdot \frac{3.3 - 20 \cdot 10^{-6} \cdot 50 - 1.8}{(20 + 2) \cdot 10^{-6}} \, s = 54509 \, s \approx 15 \, \text{hours}$$

Symbol	Description	Depends on	Example value
t	Back-up time (s)	Result	approximately 15 hours
C	Capacitance of EDLC (F)	EDLC	0.8F (EDLC datasheet, min. value)
V_0	Supply voltage (V)	Design	3.3V (VCC, supply voltage)
V_1	Cut-off voltage (V)	A1080	1.8V (A1080 manual)
R	Internal resistance at 1kHz (Ω)	EDLC	50 Ω (EDLC datasheet)
i_l	Leakage current (A)	EDLC	2µA (estimation)
i	Current during backup (A)	A1080	20µA (A1080 manual)

The values are derived from the EDLC datasheet [6] and the A1080 receiver manual [7]. Please consider the result as an indication for the expected backup time only, as there are many factors influencing the actual result: component variation, aging, temperature and humidity. Last, but not least, this example calculation is based on the assumption, that the EDLC is fully charged at the beginning of the backup period. With a circuit according to section **10.6 Battery Back-up** of the A1080 Manual [7] the EDLC is charged through a nom. 100 Ω resistor (part of the A1080) connected to VCC. This resistance has to be added to the internal resistance of the chosen EDLC to calculate the charging time. Depending on the actual capacitance and resistance involved the charging time may easily be in the range of several minutes up to even hours!

4 References

[1] Wikipedia: EDLC
http://en.wikipedia.org/wiki/EDLC

[2] Panasonic: About Gold Capacitors
http://www.panasonic.com/industrial/components/pdf/about_gold_capacitors.pdf

[3] Panasonic: Gold Capacitor Application Guidelines
http://www.panasonic.com/industrial/components/pdf/ABC0000PE41.pdf

[4] Panasonic: Gold Capacitor Technical Guide
http://www.panasonic.com/industrial/components/pdf/goldcap_tech-guide_052505.pdf

[5] Panasonic: Quick Selection Guide
http://www.panasonic.com/industrial/components/pdf/weblc_qsg_lytic_0905.pdf

[6] Panasonic: Datasheet EECF5R5H105
http://www.panasonic.com/industrial/components/pdf/ABC0000CE5.pdf

5 Related Information

5.1 Contact

This manual was created with due diligence. We hope that it will be helpful to the user to get the most out of the GPS module.

Anyway, inputs about errors or mistakable verbalizations and comments or proposals to Vincotech, Germany, for further improvements are highly appreciated.

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5.2 Related Documents

- GPS Receiver A1080 (Vincotech)
- GPS Receiver A1035-D (Vincotech)