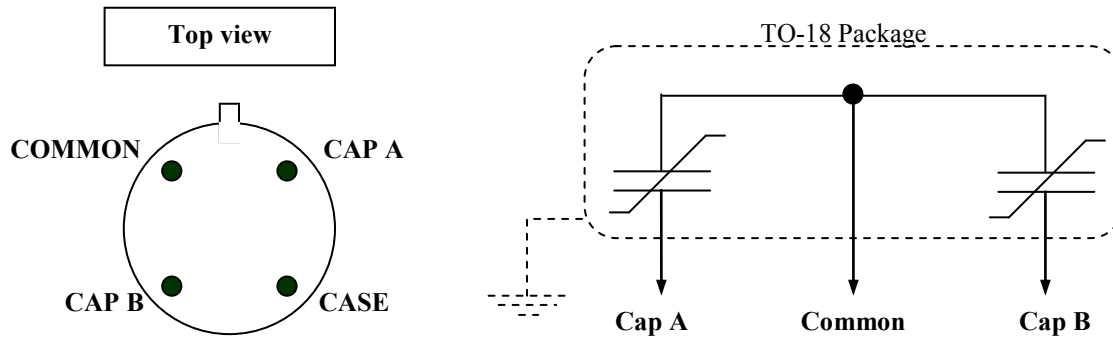


## RTAD Dual Ferroelectric Capacitors in TO-18 Package

**Date:** April 16, 2013

### Summary:

The RTAD package contains two identical 3% niobium-doped 20/80 PZT capacitors with platinum electrodes. Each die is packaged in a four-lead TO-18 header. One package lead connects to the case and is labeled GND. The two capacitors share a single COMMON but have separate leads for their other electrodes. The COMMON lead connects to a common bottom electrode.



**Temperature Range:** 0°C to 85°C. Do not exceed 85°C.

**Absolute Maximum Voltage:** 5V

### Structural Specification:

“AD” 1400Å thick 3/20/80 PNBZT with platinum electrodes and glass passivation.

### Part Number Capacitor Area

AD104	100,000 $\mu^2$
AD403	40,000 $\mu^2$
AD103	10,000 $\mu^2$
AD402	4,000 $\mu^2$
AD102	1,000 $\mu^2$
AD401	400 $\mu^2$
AD101	100 $\mu^2$

**Total PZT Lead Content per Die:** 1.7  $\mu$ grams

**Maximum Voltage for Normal Operation:** 4.2V

**Fatigue Limit to 50%:** 1,000,000 cycles

**Imprint Lifetime RT:** >30 years

**Imprint Lifetime 85°C:** TBD

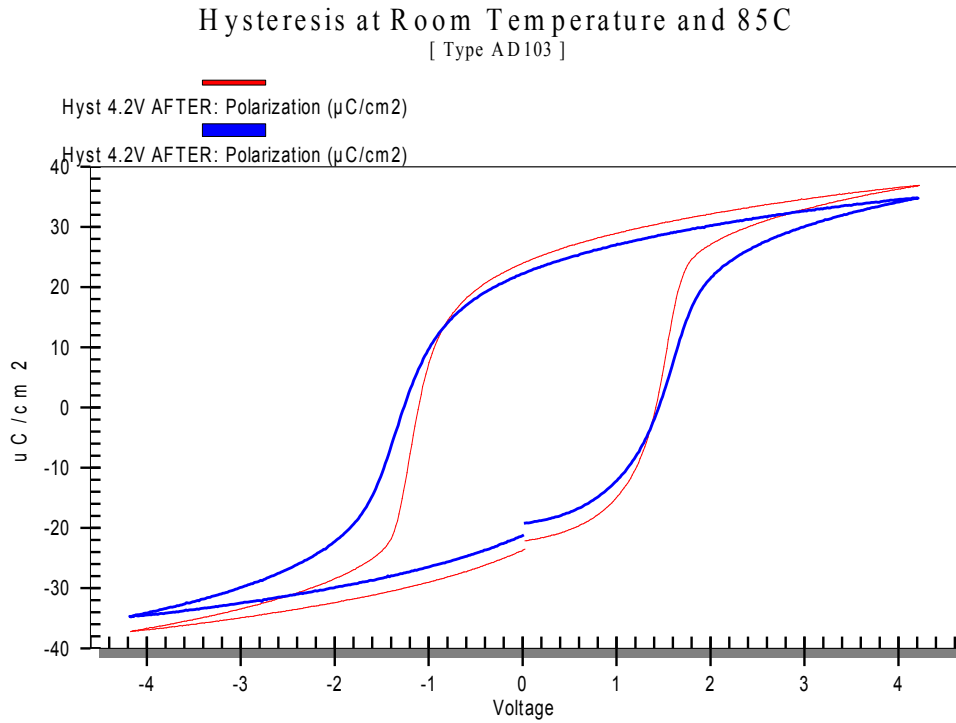
**Recovery:** 5V 1Hz square wave for 100 seconds from room temperature to 85°C.

**EDU Compatibility:** The EDU can test Type AD capacitors of 10,000 $\mu\text{m}^2$  area (AD103) or less. All other Radiant testers can test all Type AD capacitors regardless of area.

*For an explanation of the specifications, see “Explanation of Ferroelectric Capacitor Properties.”*

**Data Plots:**

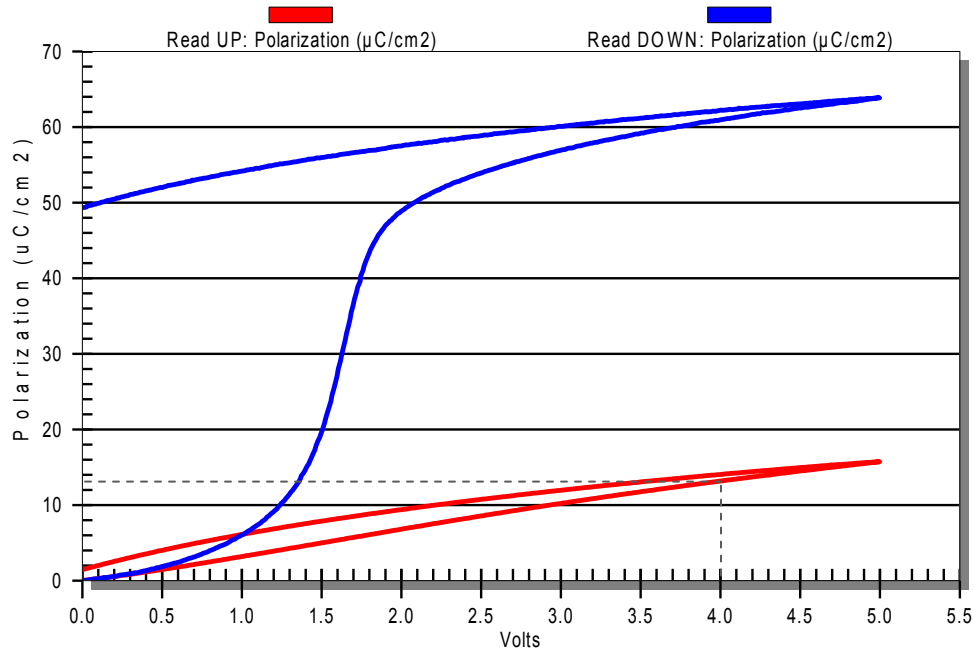
Polarization



The **Blue** loop in the plot above is the room temperature hysteresis of the Type AD capacitor. The **Red** loop is the response at 85°C.

## Switched vs Unswitched Half-Loops at Room Temperature

[ RTAD104 ]



To determine the charge generated by a capacitor of specific area, multiply the polarization value from the chart above by the area of the capacitor. Always use the bottom, upward-going half of each trace.

Example:

What is the charge generated at 4.0 volts non-switching for a 10,000µm<sup>2</sup> capacitor?

$$\text{Polarization} \times \text{Area} = \text{Charge}$$

$$13\mu\text{C}/\text{cm}^2 \times [ 10,000\mu\text{m}^2 \times (10^{-8} \text{ cm}^2/\mu\text{m}^2) ] = 1.3\text{nC}$$

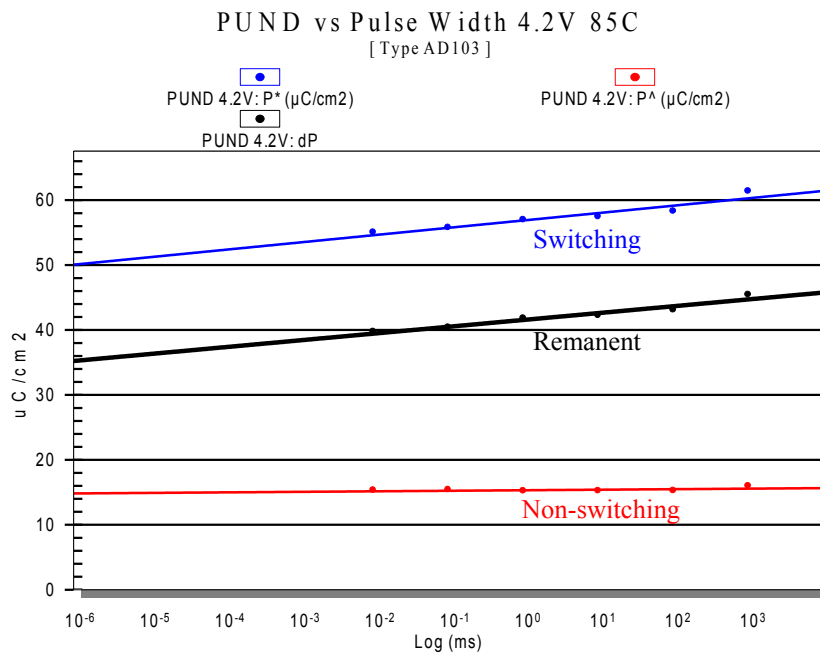
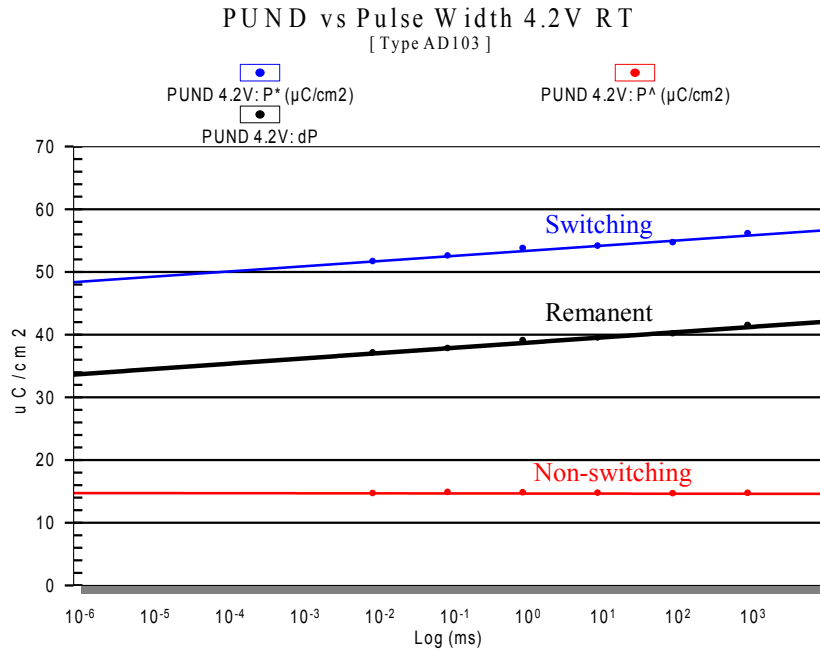
$$13\mu\text{C}/\text{cm}^2 \times 10^{-4} \text{ cm}^2 = 1.3\text{nC}$$

Note that capacitor areas are denoted in units of square microns while polarization is given in units of square centimeters. There are  $1 \times 10^8$  square microns in a square centimeter.

The Type AD capacitors are 0.14µ thick and may be operated up to 5V. The capacitor will withstand 4.2 volts or less under long term DC bias at room temperature. The Type AD is intended for operation from room temperature to 85°C and will begin to leak slightly during hysteresis loops slower than 2 seconds at 85°C.

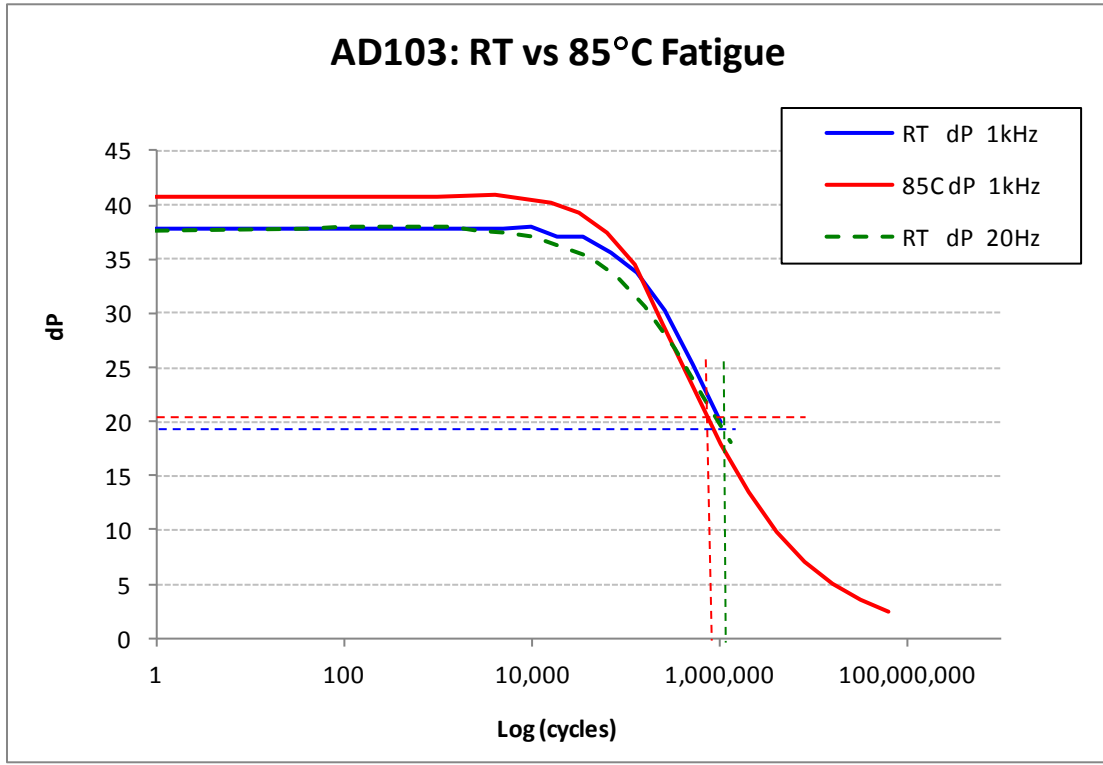
Switching Speed

The Type AD capacitors will switch faster than one microsecond. Below are the Remanent Polarization vs Pulse Width measurements for room temperature and 85°C. The capacitor under test has an area of  $10,000\mu^2$ .



### Fatigue

The Type AD capacitor has a fatigue lifetime of 1,000,000 cycles to 50% over the temperature range of room temperature to 85°C. Neither temperature nor fatigue frequency has a significant impact on fatigue lifetime.



AD103: Alternating 4.2V 10 $\mu$ s pulses with one pair executed at the frequency denoted.

## Area Designations

Area (cm <sup>2</sup> )	Alphanumeric
1x10 <sup>-2</sup>	RTAD105
1x10 <sup>-3</sup>	RTAD104
4x10 <sup>-4</sup>	RTAD403
1x10 <sup>-4</sup>	RTAD103
4x10 <sup>-5</sup>	RTAD402
1x10 <sup>-5</sup>	RTAD102
4x10 <sup>-6</sup>	RTAD401
1x10 <sup>-6</sup>	RTAD101

NOTE: The “RT” will not be included on package labels.

### Package:

Header: HDR01833  
Lid: CAN01807  
Specification: Commercial 0°C to 85°C  
Atmosphere: Air  
Bonds: Gold wire between gold bond pads and gold coated posts