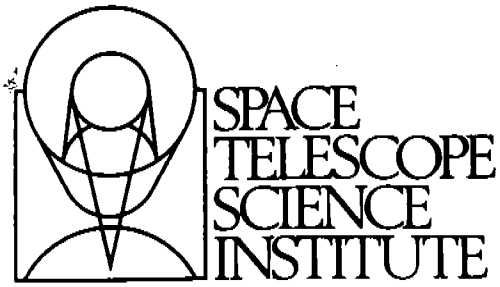

INSTRUMENT SCIENCE REPORT

CAL/FOS-010

TITLE: High Voltage Settle (FOS Calibration #8)

AUTHOR: D. Lindler and R. Bohlin

DATE: December 1984

ABSTRACT

Operational constraints allow the high voltage to be on for only one FOS detector at a time. After turning on the high voltage, the electric field in the Digicons requires time to achieve equilibrium. For the first 30 minutes after high voltage turn on, large image shifts (on the order of 1 micron per minute) are present. This motion decreases to less than 2 microns per hour after 60 minutes. Studies of the motion for a longer period using data taken to measure aperture repeatability, showed a small (1.2 micron/hour) drift up to five hours after turn on. However, this drift may be due to temperature effects.

The aperture repeatability data demonstrated that the aperture position on the photocathode was repeatable to within one micron.

During the transition from cold to hot operate, a motion of the spectrum along the diode array of 32 microns was measured on the blue side for a change of 5C in the optical bench temperature.

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I. Calibration Data

To monitor the image stability after high voltage turn on, a series of platinum-neon spectra was taken using grating H27. Data were acquired for both detectors for a period of one hour after high voltage turn on. Data were taken at both cold and hot operate temperatures. To monitor the image stability for a longer period these data were supplemented with data taken to measure the aperture wheel repeatability. These later data were only available on the red side and extended to five hours after high voltage turn on.

II. Data Analysis

Motion between spectra was computed using cross-correlation techniques. In order to analyze motion versus diode position, the data were separated into groups containing diodes 1-100, 101-200, 201-300, 301-400 and 401-500. Cross-correlation was done on each group separately. To obtain motion estimates below the 50 micron resolution (pixel separation was 12.5 microns) the minimum of the correlation matrix was found and a quadratic fit was done using that point and its two neighbors. The position of the minimum of the quadratic fit was used to give the relative spectral motion.

III. Results

Figures 1 to 5 show the results for the blue tube in hot and cold operate. All shifts are relative to the last spectrum taken at cold operate. Large image motions are seen for the first 30 minutes with the largest shifts at the two ends of the diode array. The large offsets between the hot and cold operate spectra, seen 60 minutes after turn on, are due to the lack of perfect repeatability of the filter grating wheel. Figures 6 to 10 show similar results for the red tube.

Figures 11 to 15 show an attempt to measure the high voltage settling after one hour using data taken to study the aperture wheel repeatability. All motion is relative to zero motion at 60 minutes after turn on. The aperture repeatability data were shifted in time by 45 minutes to match the previous data. After 100 minutes all diodes moved in the same direction at a rate of 1.2 microns per hour. This small drift may be thermal or may be due to a slow trend of the Digicon electric fields toward equilibrium. Figure 16 shows an optical bench temperature over the time period that the aperture repeatability data was taken. The drift of five to six microns from time 100 to 300 minutes with a temperature change of about one degree is consistent with the thermal motion measured on the blue side over a 5 degree temperature transition. Over the 5 degrees, the blue side showed an average of 6.4 microns per degree shift (see Figure 17). Figures 11 to 15 also show as a by-product that the aperture wheel is repeatable to within a micron (as measured by the scatter of the data points from a smooth line).

Figure 1:

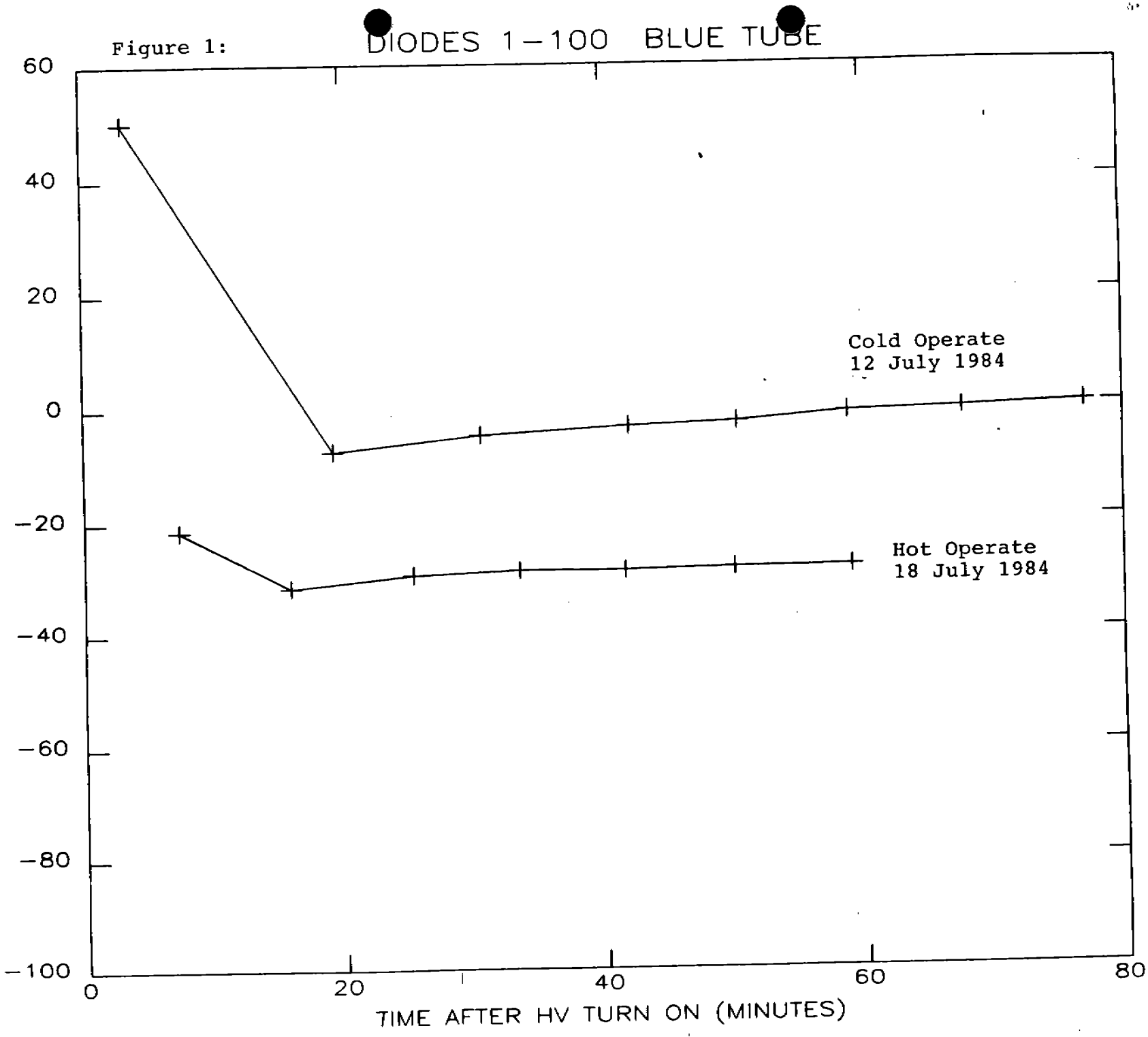
DIODES 1–100 BLUE TUBE
60
40
20
0
−20
−40
−60
−80
−100
RELATIVE SPECTRAL SHIFT (MICRONS)
Cold Operate
12 July 1984
Hot Operate
18 July 1984
0
20
40
60
80
TIME AFTER HV TURN ON (MINUTES)

Figure 2:

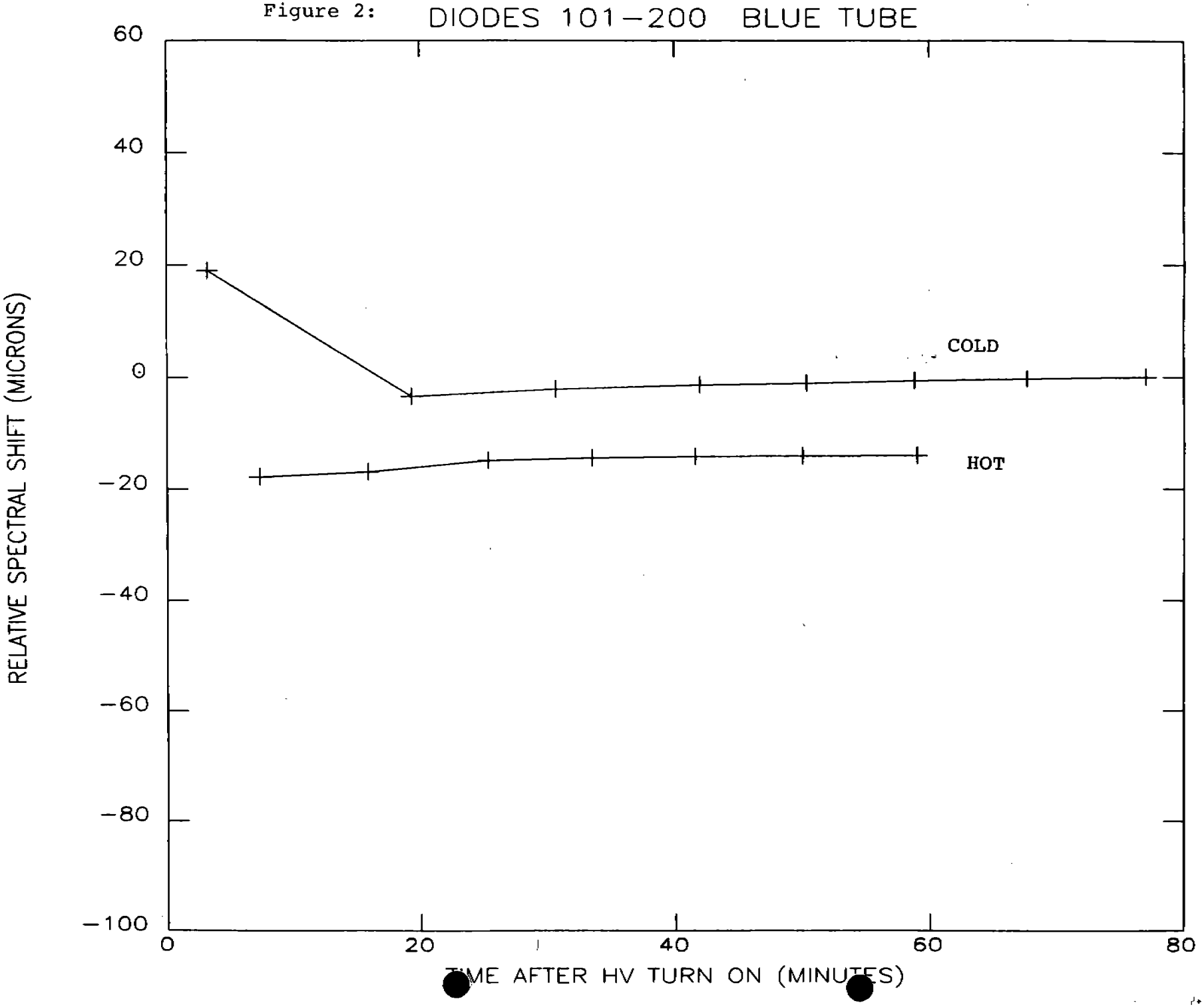
DIODES 101–200 BLUE TUBE
60
40
20
0
−20
−40
−60
−80
−100
RELATIVE SPECTRAL SHIFT (MICRONS)
COLD
HOT
0
20
40
60
80
TIME AFTER HV TURN ON (MINUTES)

Figure 3:

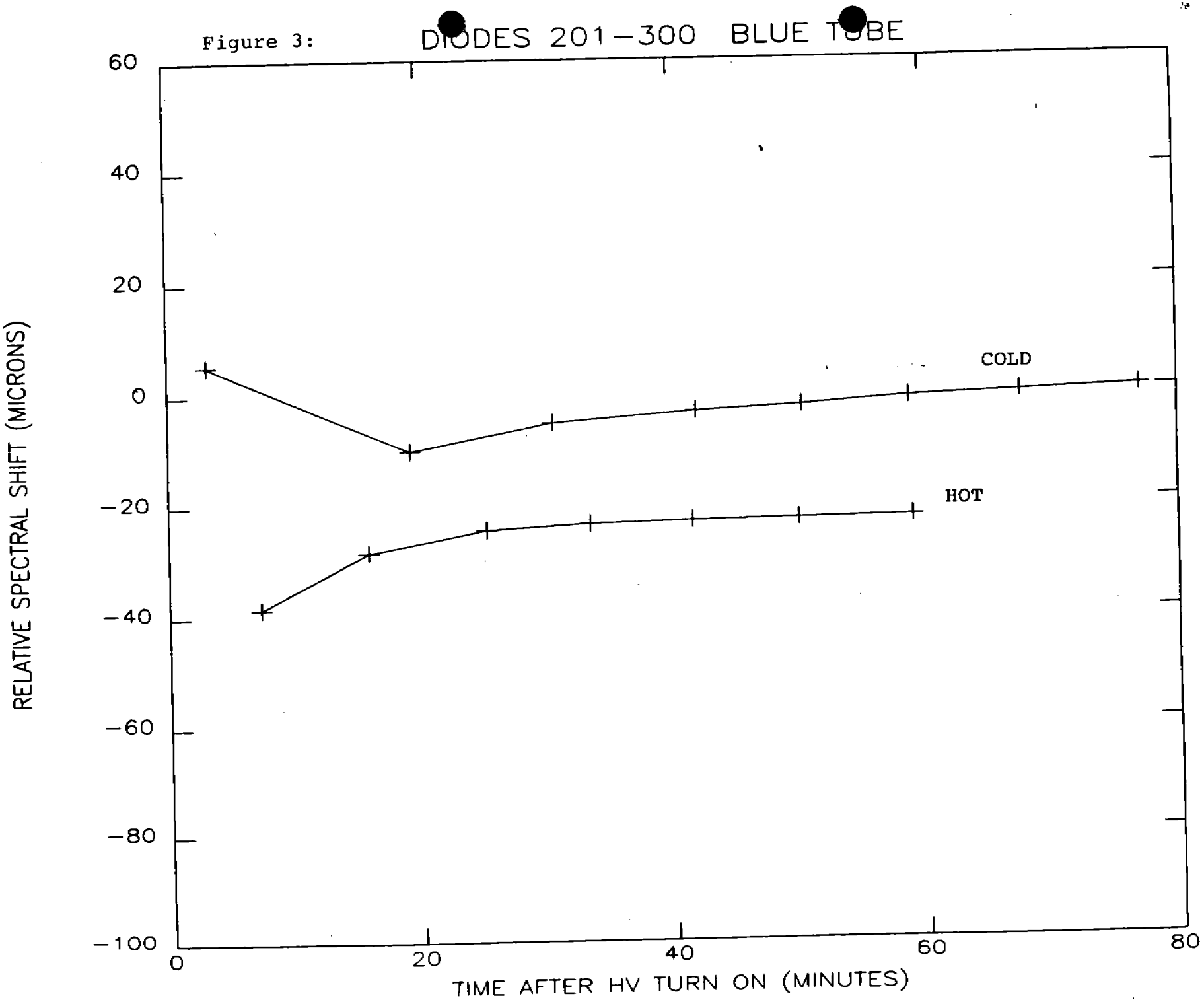
DIODES 201-300 BLUE TUBE
60
40
20
0
-20
-40
-60
-80
-100
RELATIVE SPECTRAL SHIFT (MICRONS)
COLD
HOT
0
20
40
60
80
TIME AFTER HV TURN ON (MINUTES)

Figure 4:

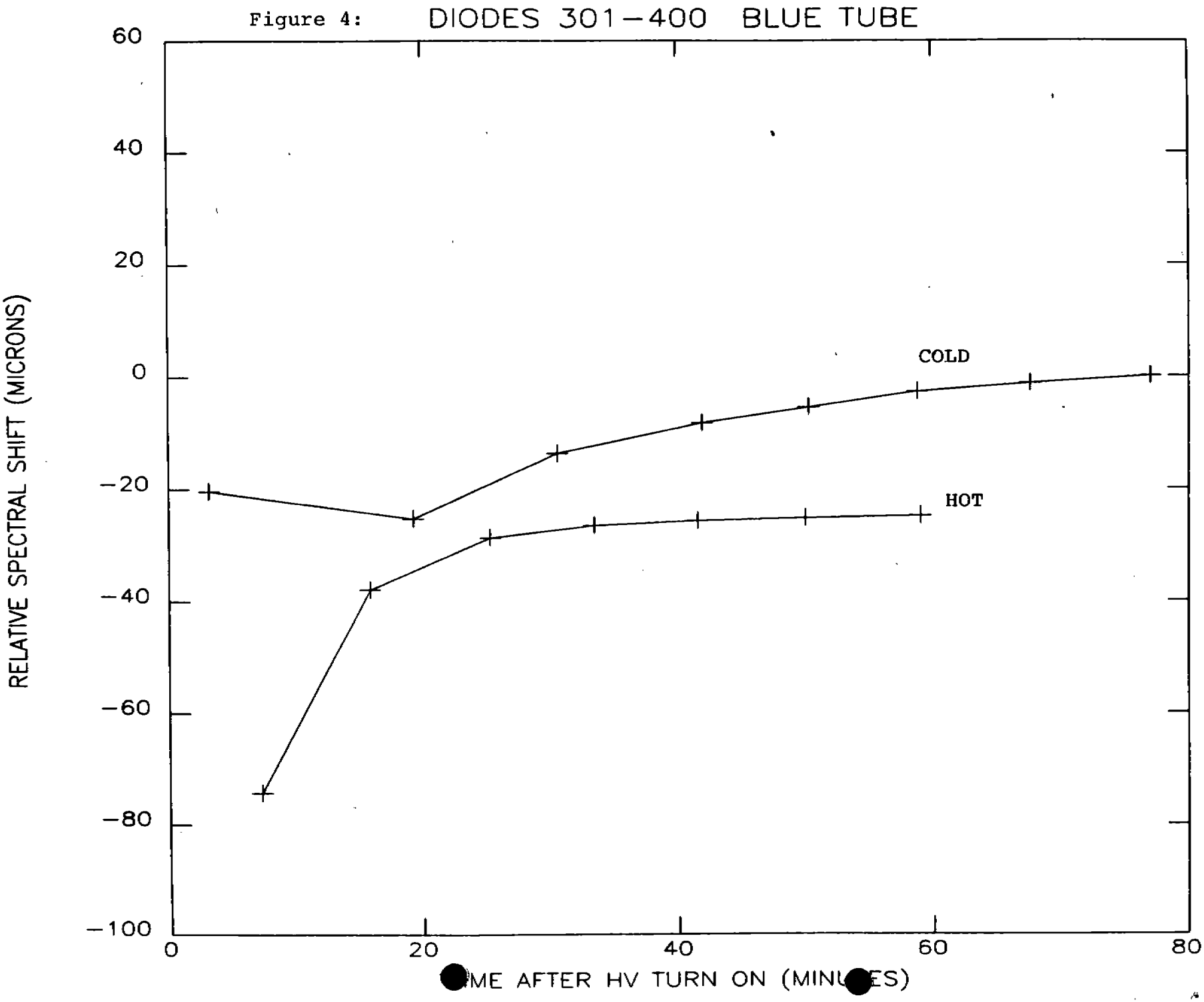
DIODES 301–400 BLUE TUBE
60
40
20
0
−20
−40
−60
−80
−100
RELATIVE SPECTRAL SHIFT (MICRONS)
COLD
HOT
0
20
40
60
80
ME AFTER HV TURN ON (MIN ES)

Figure 15:

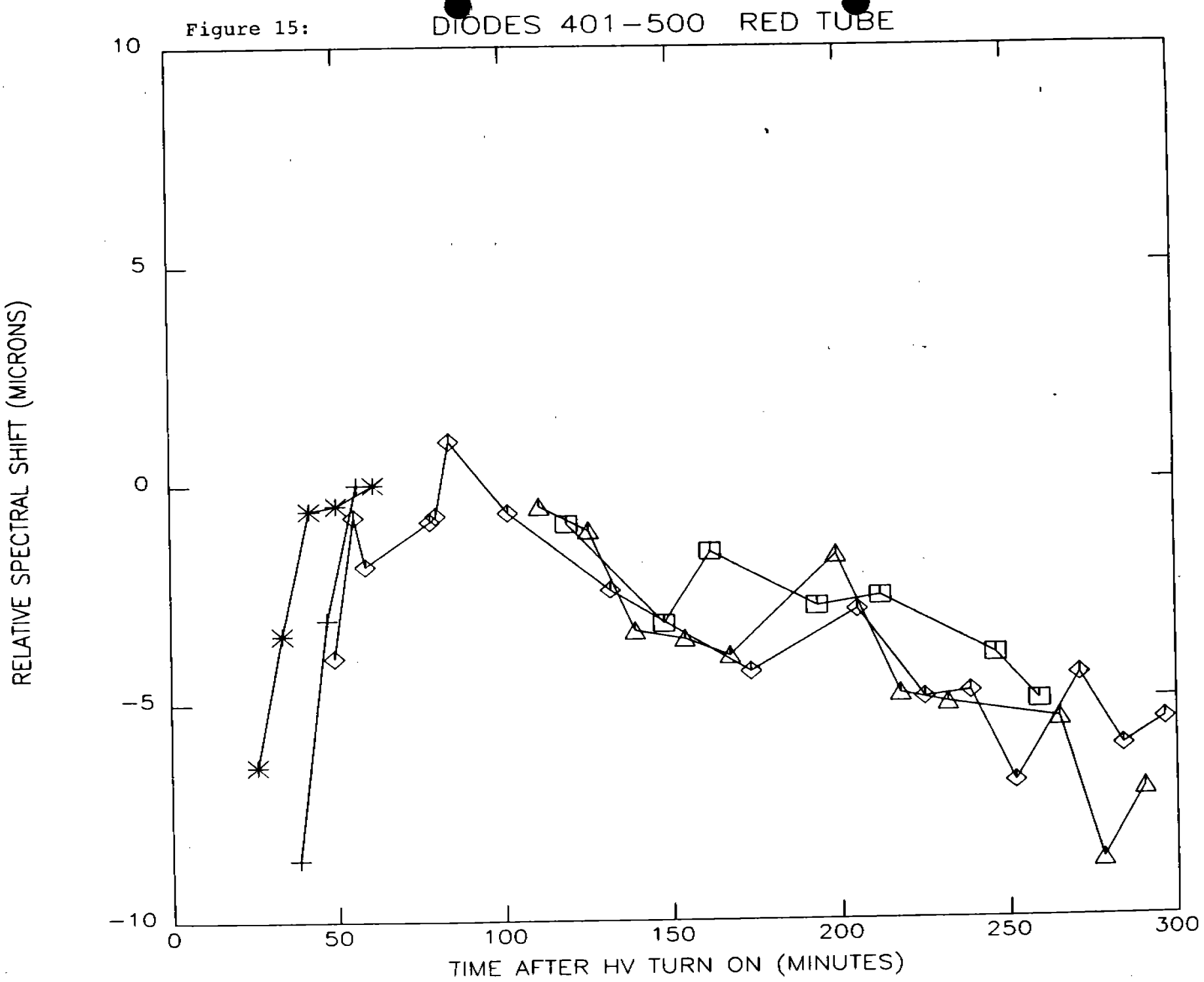
DIODES 401-500 RED TUBE
RELATIVE SPECTRAL SHIFT (MICRONS)
10
5
0
-5
-10
0
50
100
150
200
250
300
TIME AFTER HV TURN ON (MINUTES)

Figure 16.

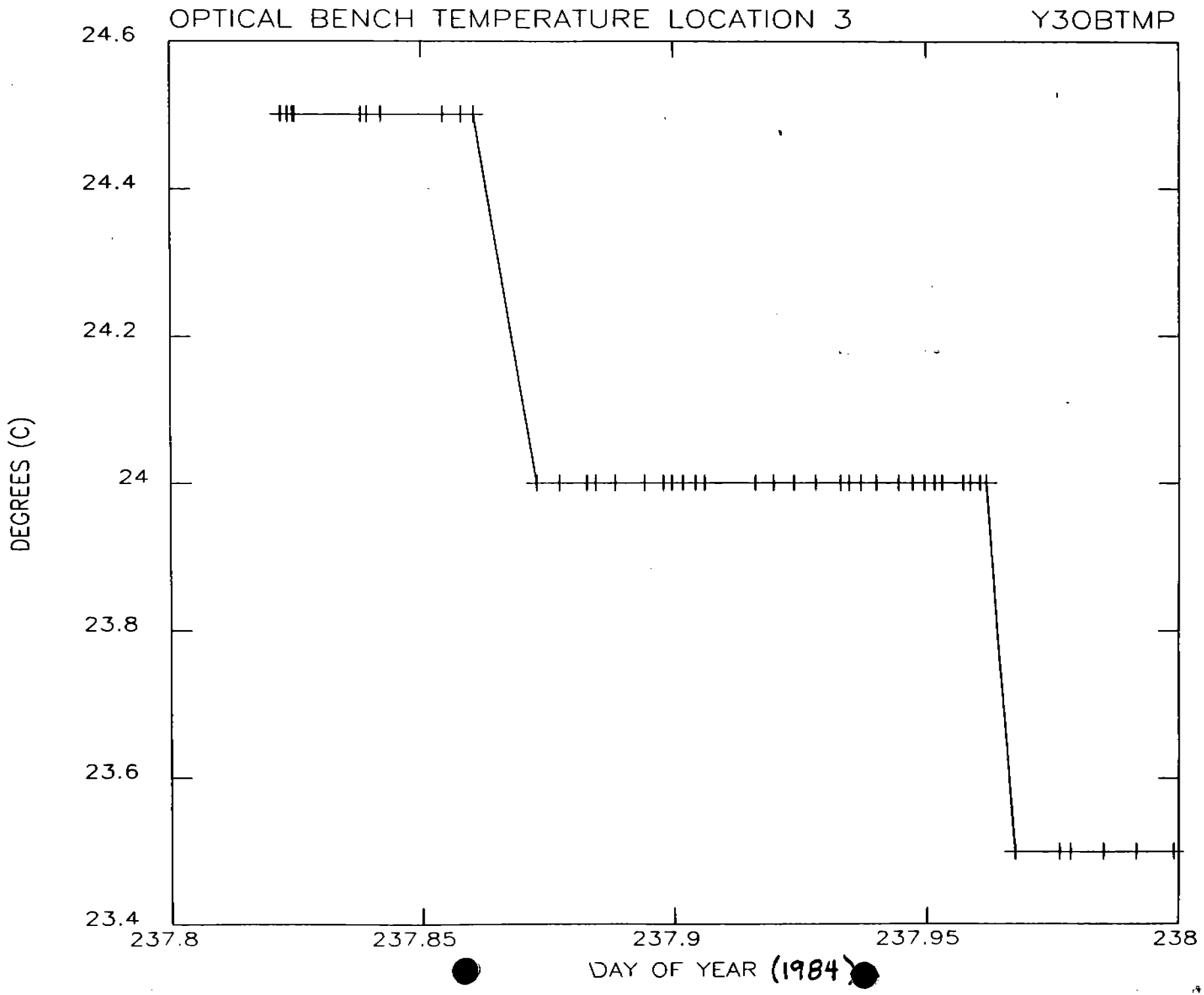
OPTICAL BENCH TEMPERATURE LOCATION 3
Y3OBTMP
24.6
24.4
24.2
24
23.8
23.6
23.4
DEGREES (C)
237.8
237.85
237.9
237.95
238
DAY OF YEAR (1984)

Figure 11:

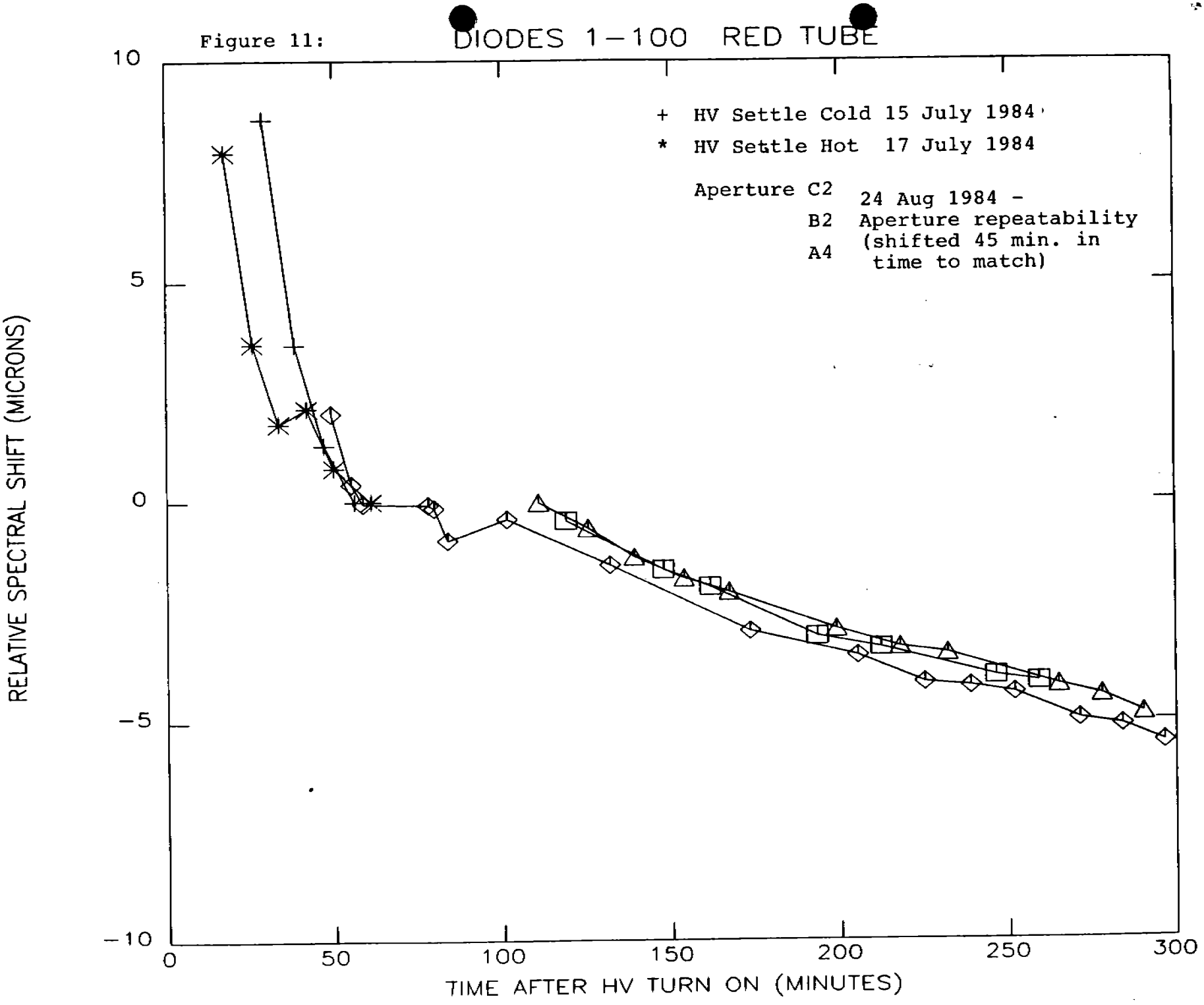
DIODES 1–100 RED TUBE
+ HV Settle Cold 15 July 1984
* HV Settle Hot 17 July 1984
Aperture C2
B2
A4
24 Aug 1984 - Aperture repeatability (shifted 45 min. in time to match)
RELATIVE SPECTRAL SHIFT (MICRONS)
10
5
0
−5
−10
0
50
100
150
200
250
300
TIME AFTER HV TURN ON (MINUTES)

Figure 12:

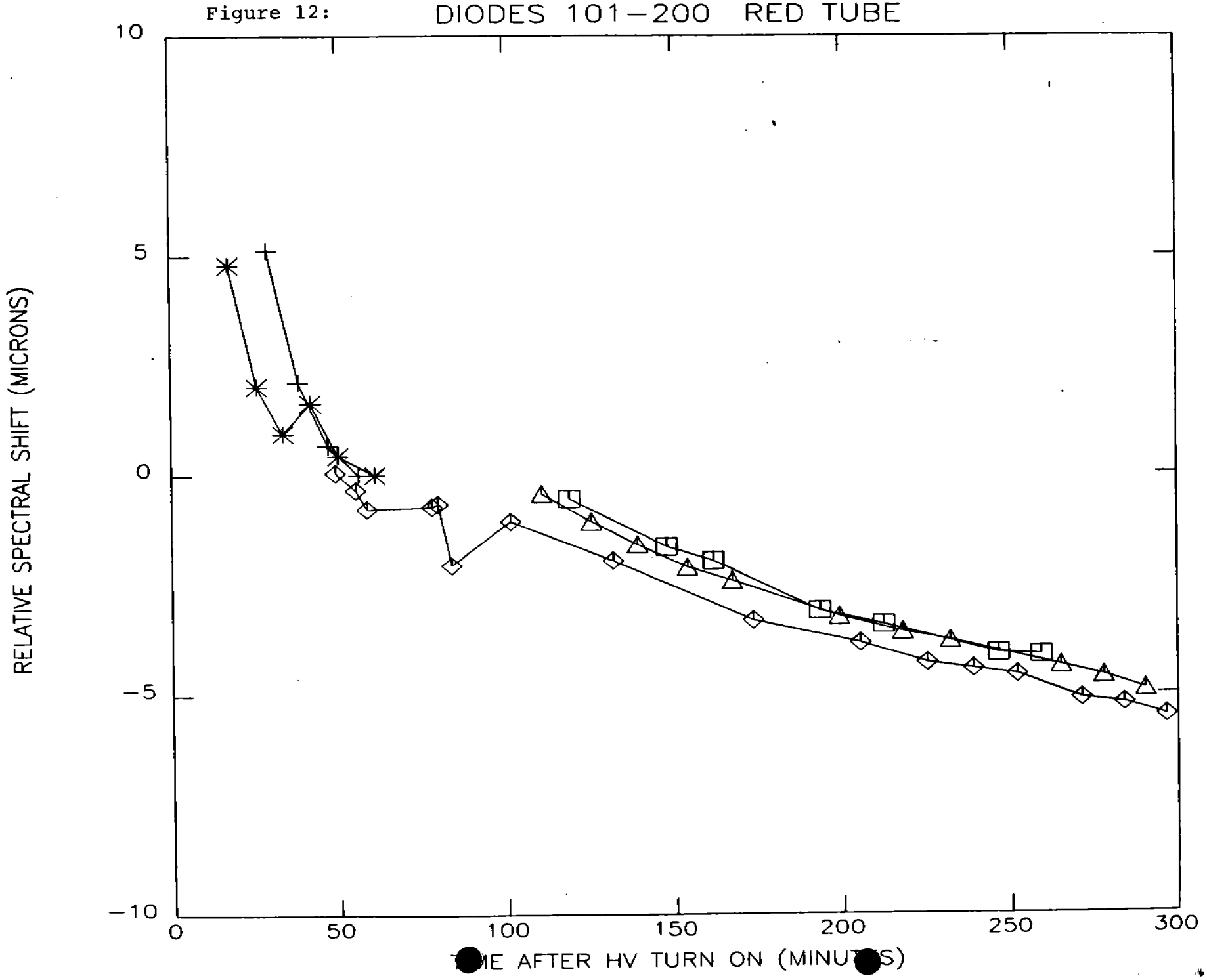
DIODES 101–200 RED TUBE
10
5
0
−5
−10
RELATIVE SPECTRAL SHIFT (MICRONS)
0
50
100
150
200
250
300
IME AFTER HV TURN ON (MINUTES)

Figure 13

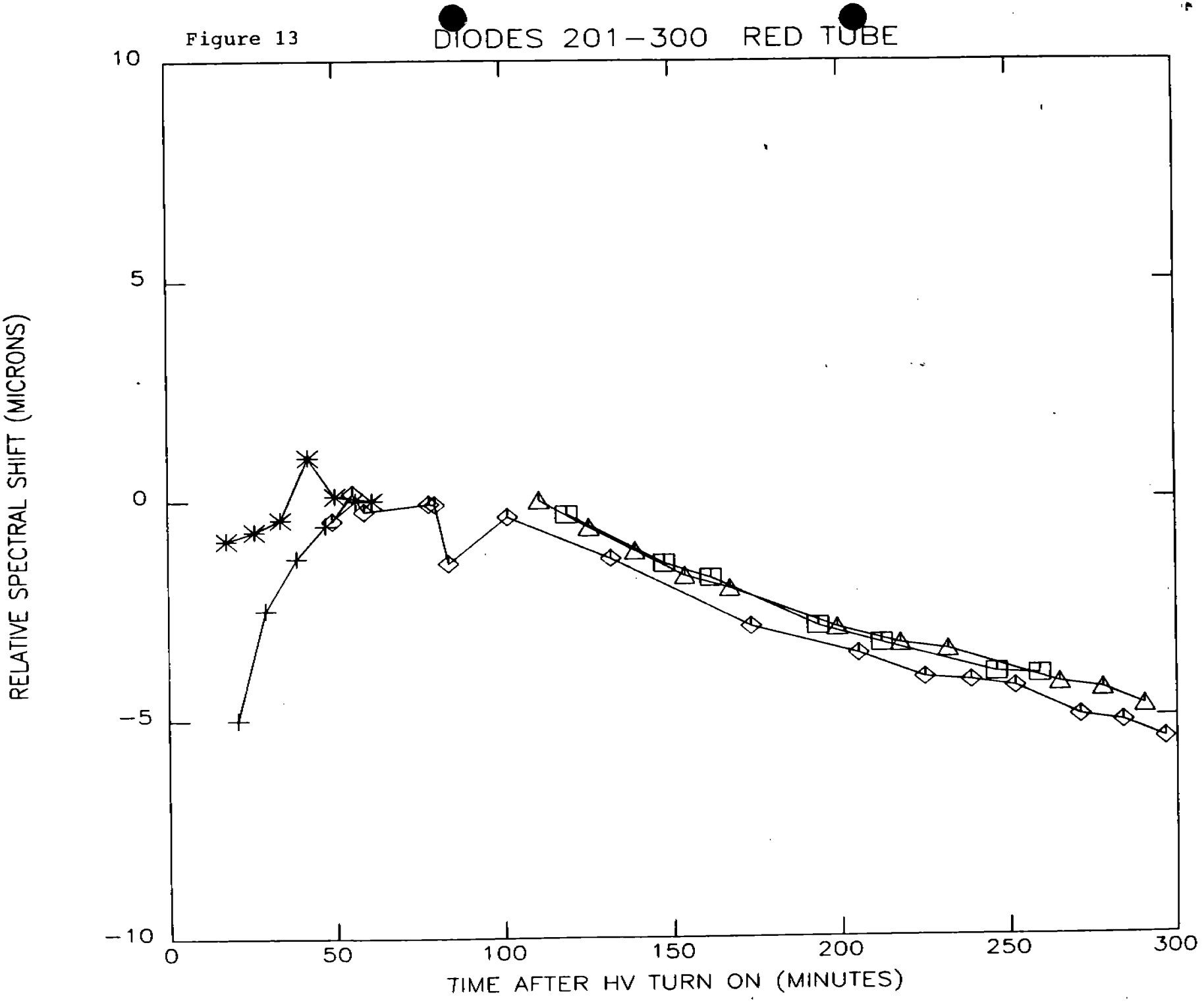
DIODES 201–300 RED TUBE
10
5
0
−5
−10
0
50
100
150
200
250
300
RELATIVE SPECTRAL SHIFT (MICRONS)
TIME AFTER HV TURN ON (MINUTES)

Figure 14:

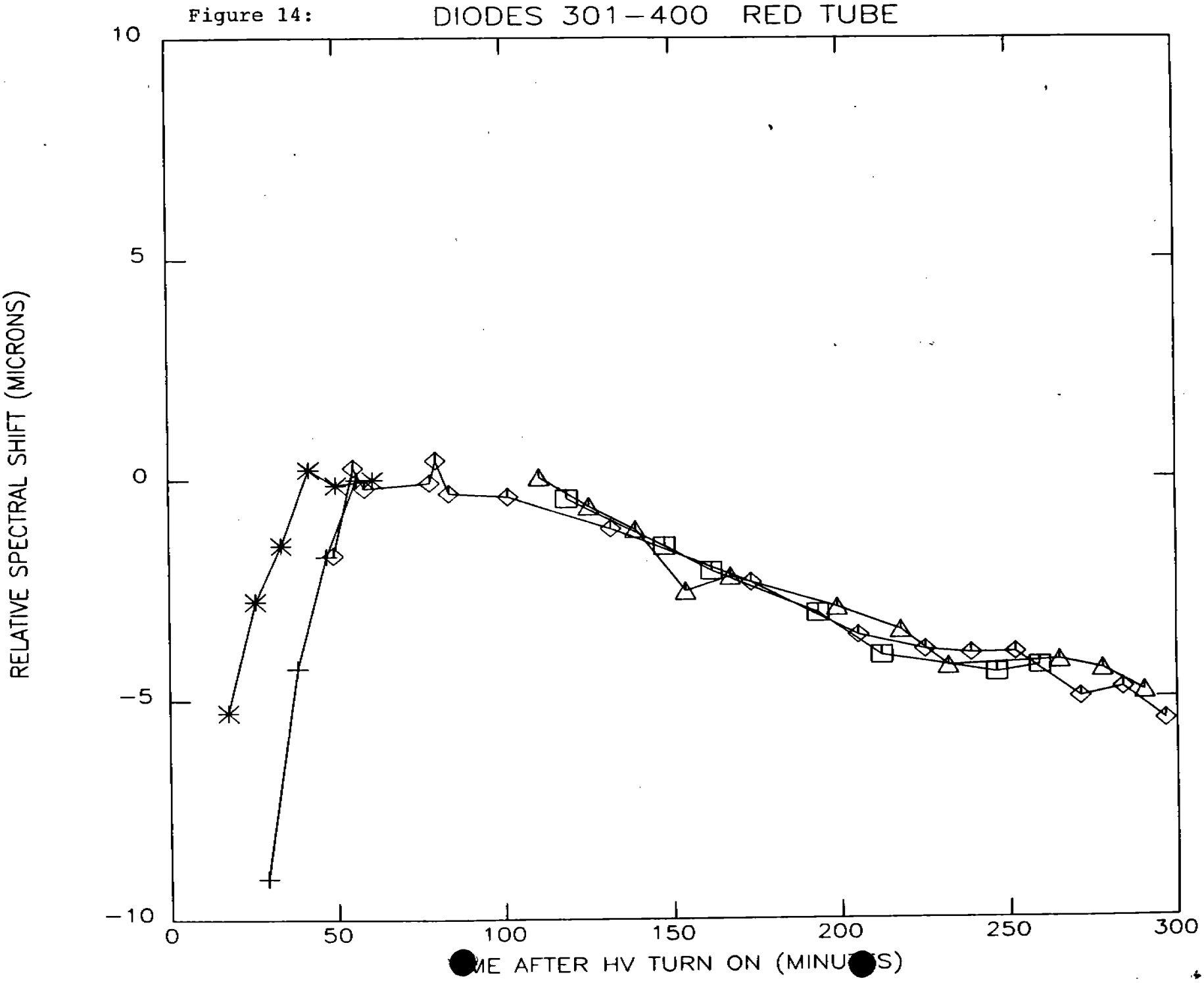
DIODES 301–400 RED TUBE
10
5
0
−5
−10
RELATIVE SPECTRAL SHIFT (MICRONS)
0
50
100
150
200
250
300
ME AFTER HV TURN ON (MINU S)

Figure 5:

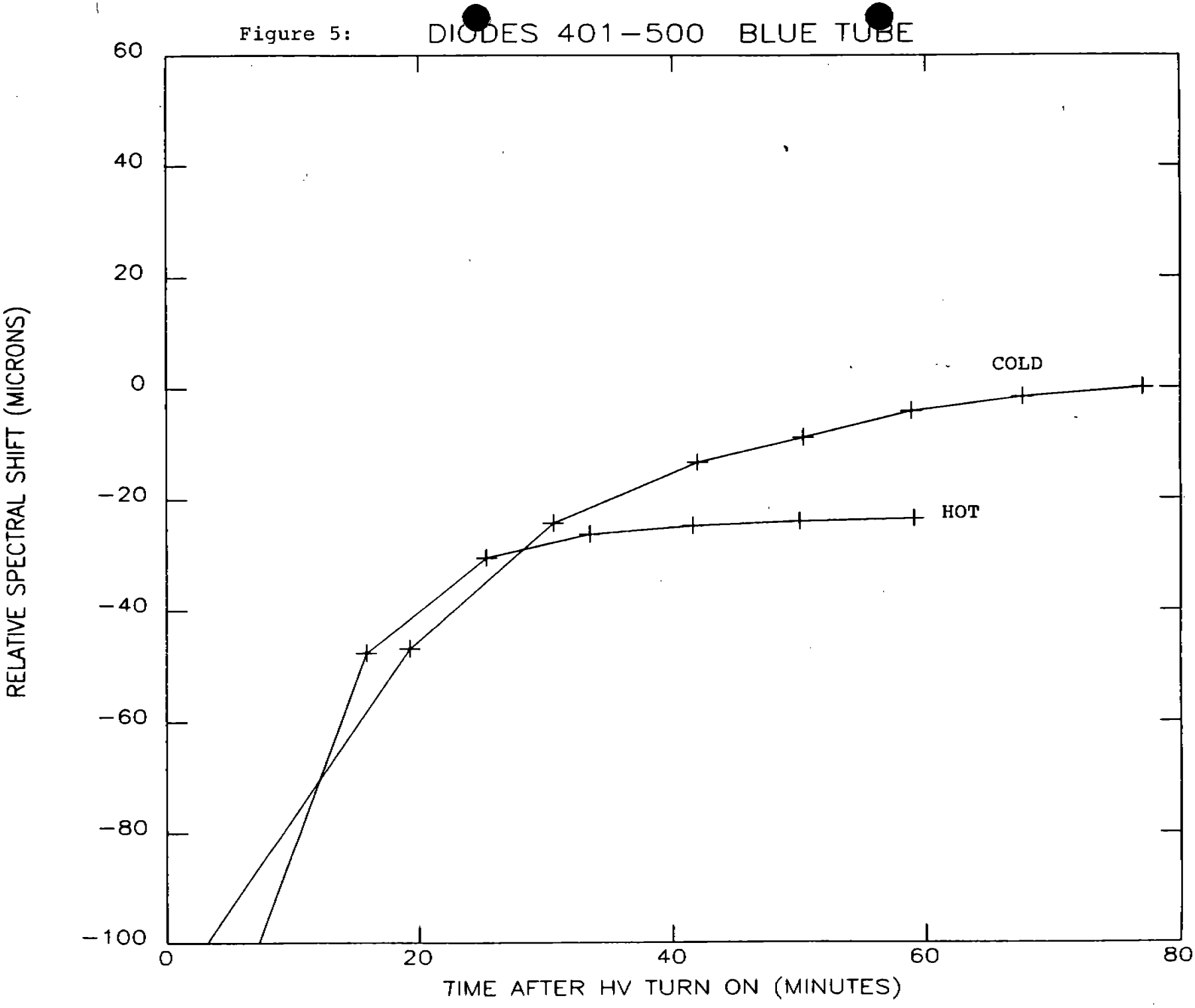
DIODES 401–500 BLUE TUBE
60
40
20
0
−20
−40
−60
−80
−100
RELATIVE SPECTRAL SHIFT (MICRONS)
COLD
HOT
0
20
40
60
80
TIME AFTER HV TURN ON (MINUTES)

Figure 6:

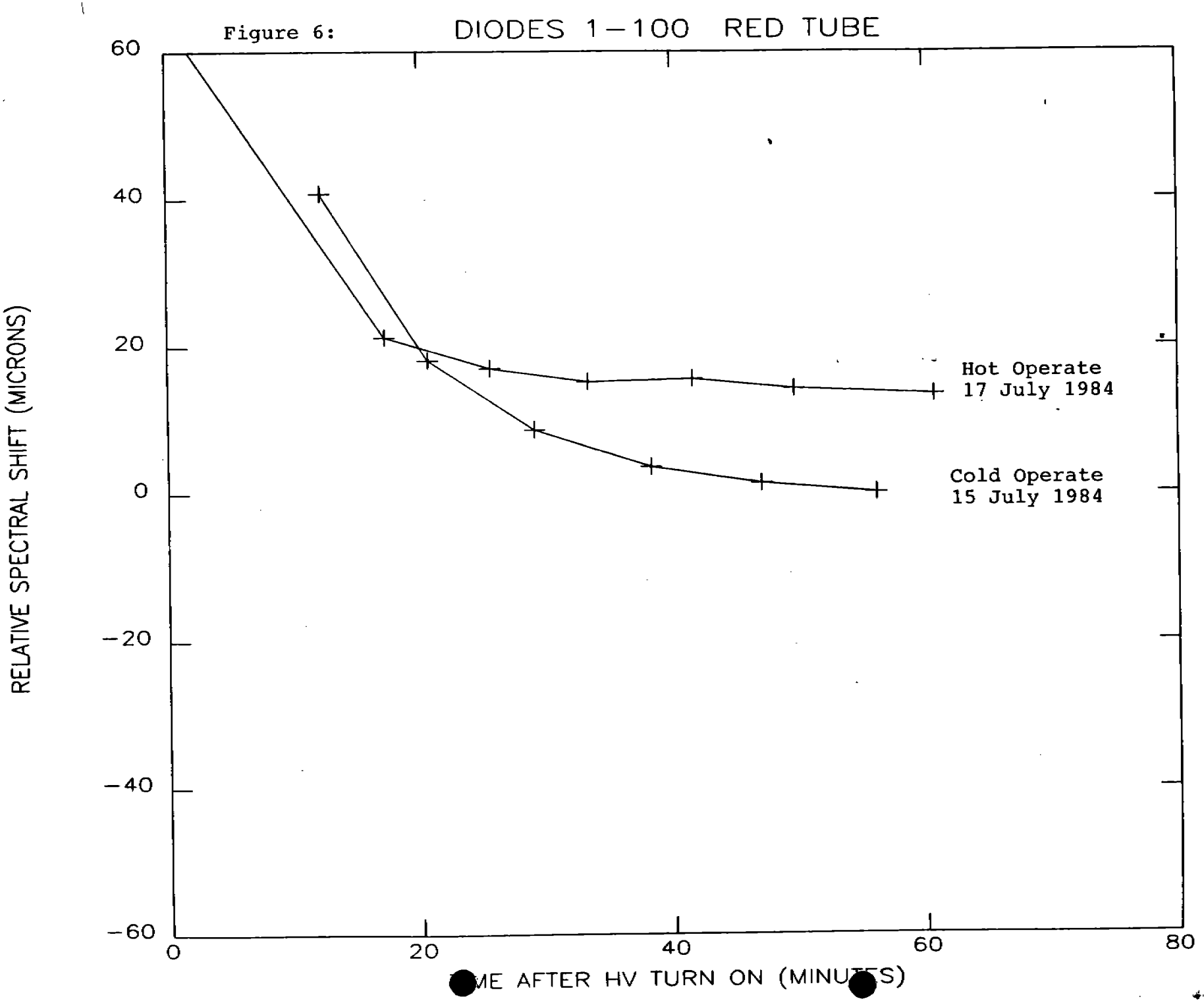
DIODES 1–100 RED TUBE
60
40
20
0
–20
–40
–60
0
20
40
60
80
RELATIVE SPECTRAL SHIFT (MICRONS)
ME AFTER HV TURN ON (MINUTES)
Hot Operate
17 July 1984
Cold Operate
15 July 1984

Figure 7:

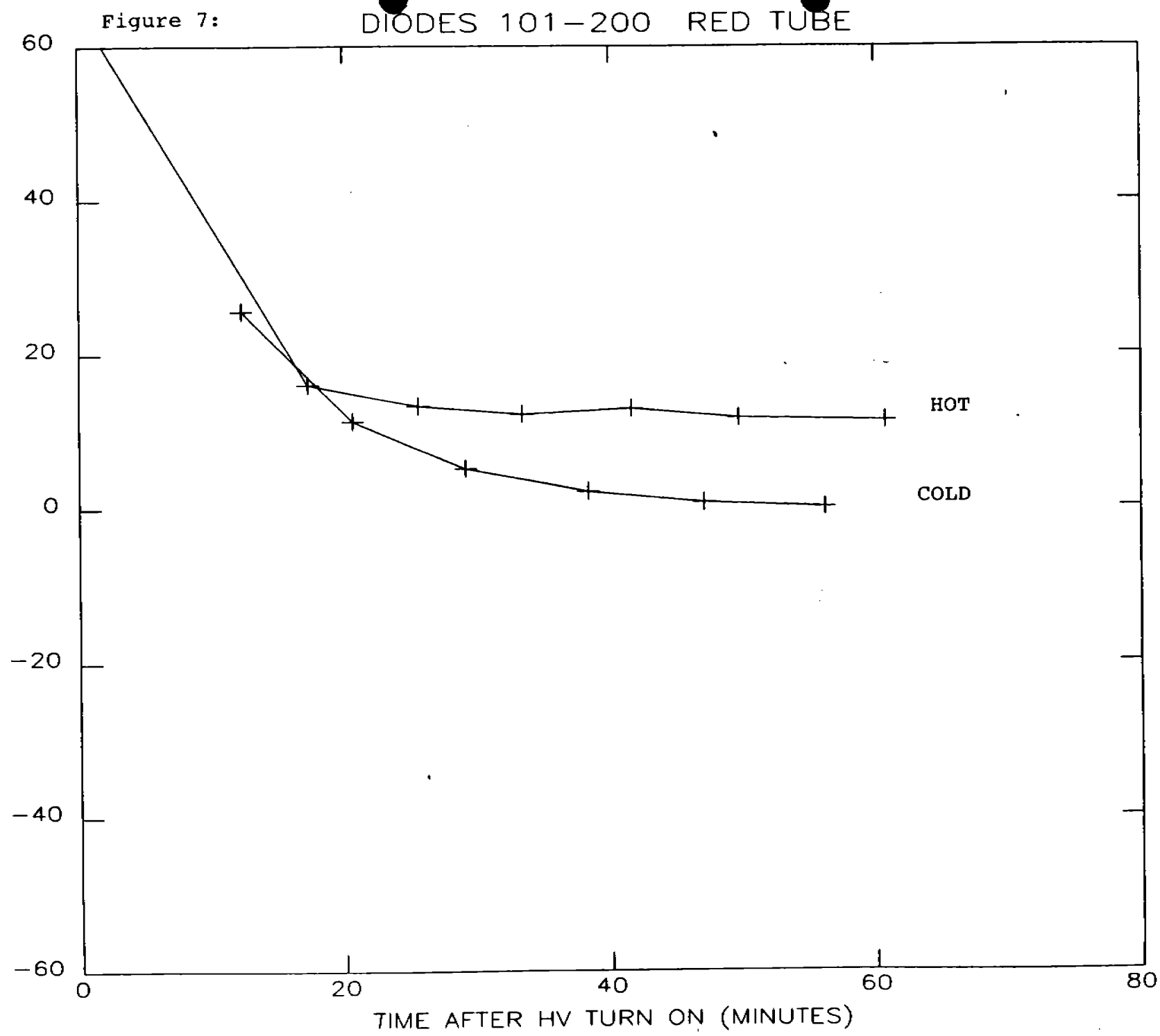
DIODES 101–200 RED TUBE
60
40
20
0
−20
−40
−60
0
20
40
60
80
RELATIVE SPECTRAL SHIFT (MICRONS)
TIME AFTER HV TURN ON (MINUTES)
HOT
COLD

Figure 8:

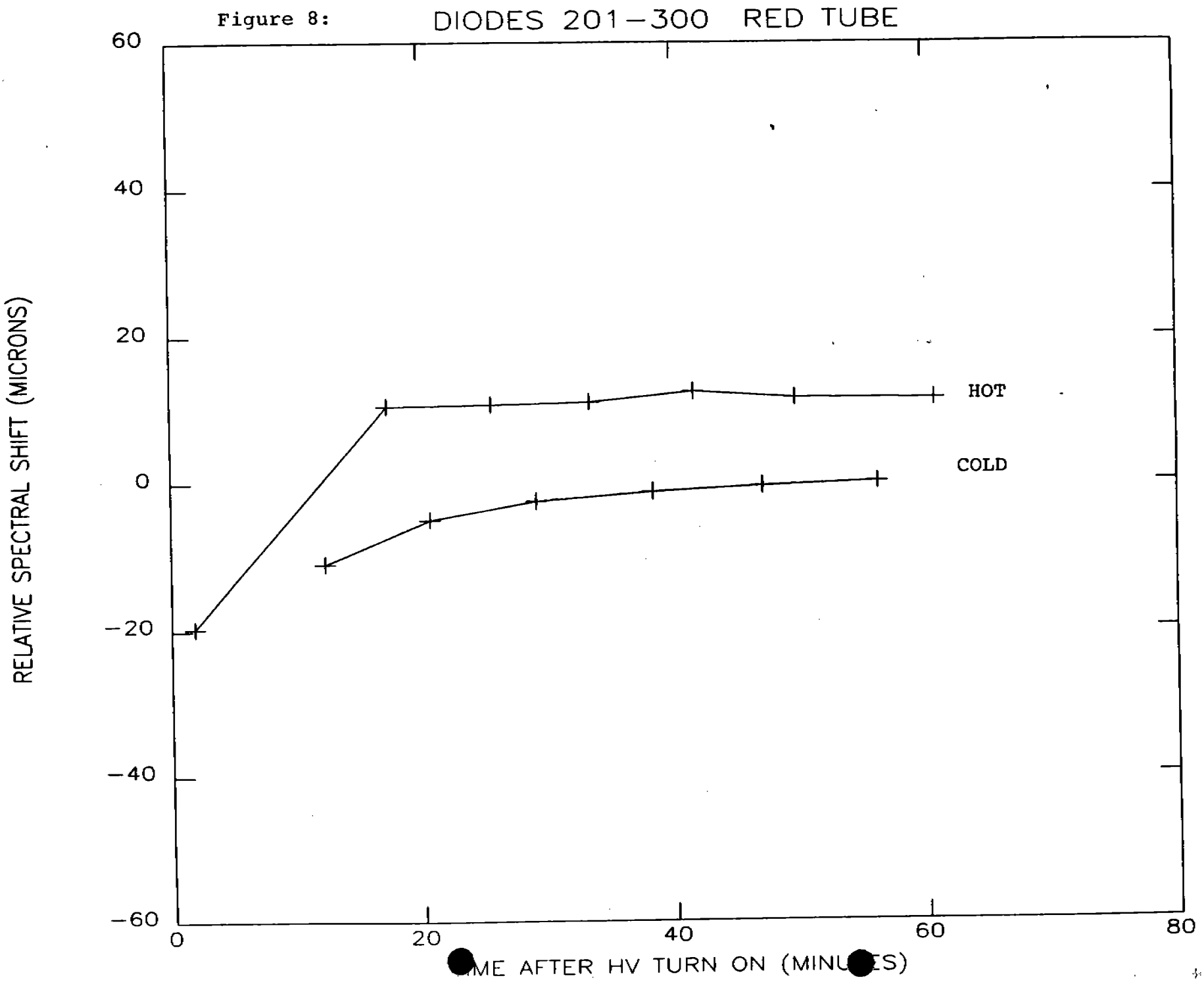
DIODES 201–300 RED TUBE
60
40
20
0
−20
−40
−60
0
20
40
60
80
HOT
COLD
RELATIVE SPECTRAL SHIFT (MICRONS)
ME AFTER HV TURN ON (MINU ES)

Figure 9:

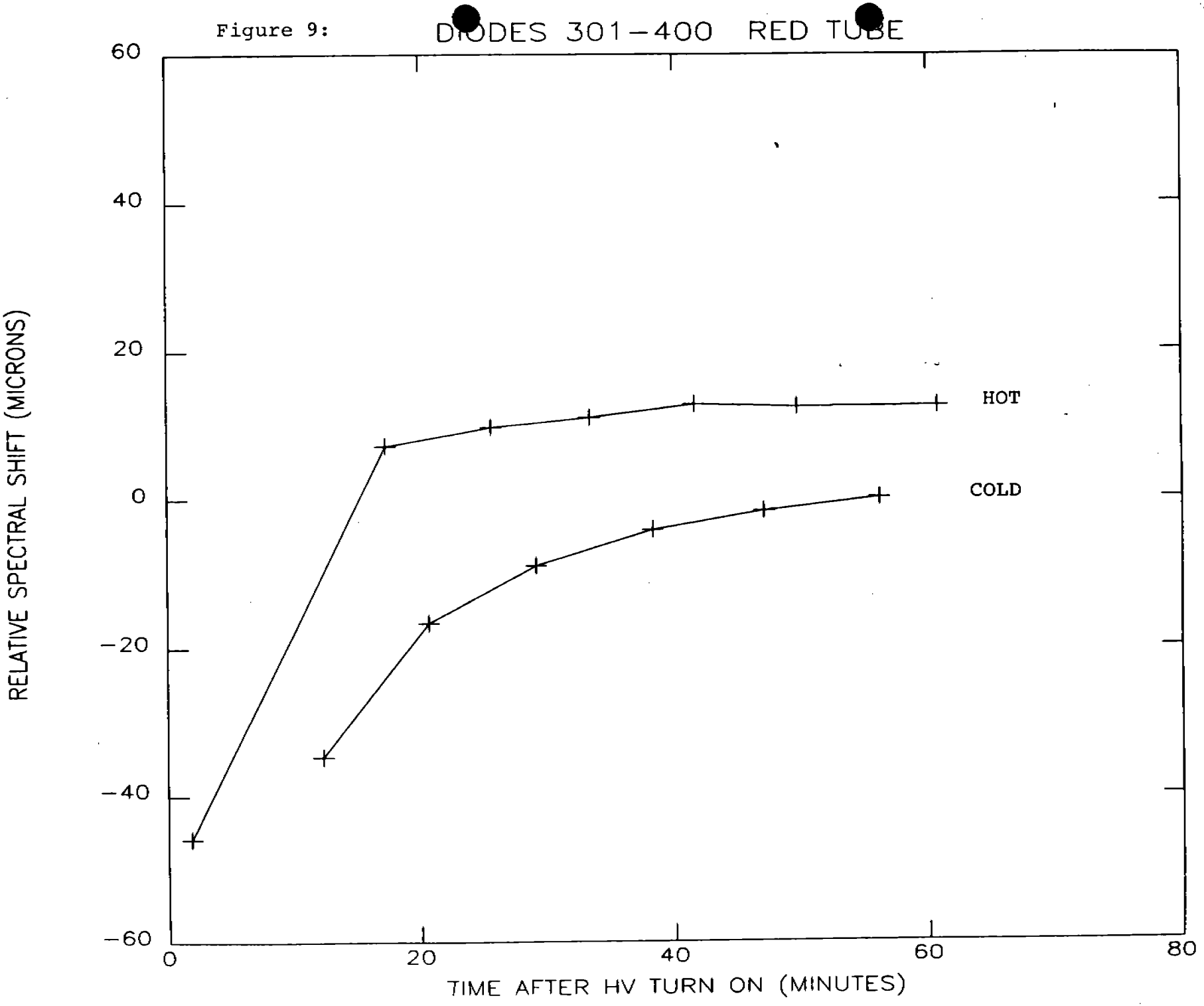
DIODES 301-400 RED TUBE
60
40
20
0
-20
-40
-60
0
20
40
60
80
RELATIVE SPECTRAL SHIFT (MICRONS)
TIME AFTER HV TURN ON (MINUTES)
HOT
COLD

Figure 10:

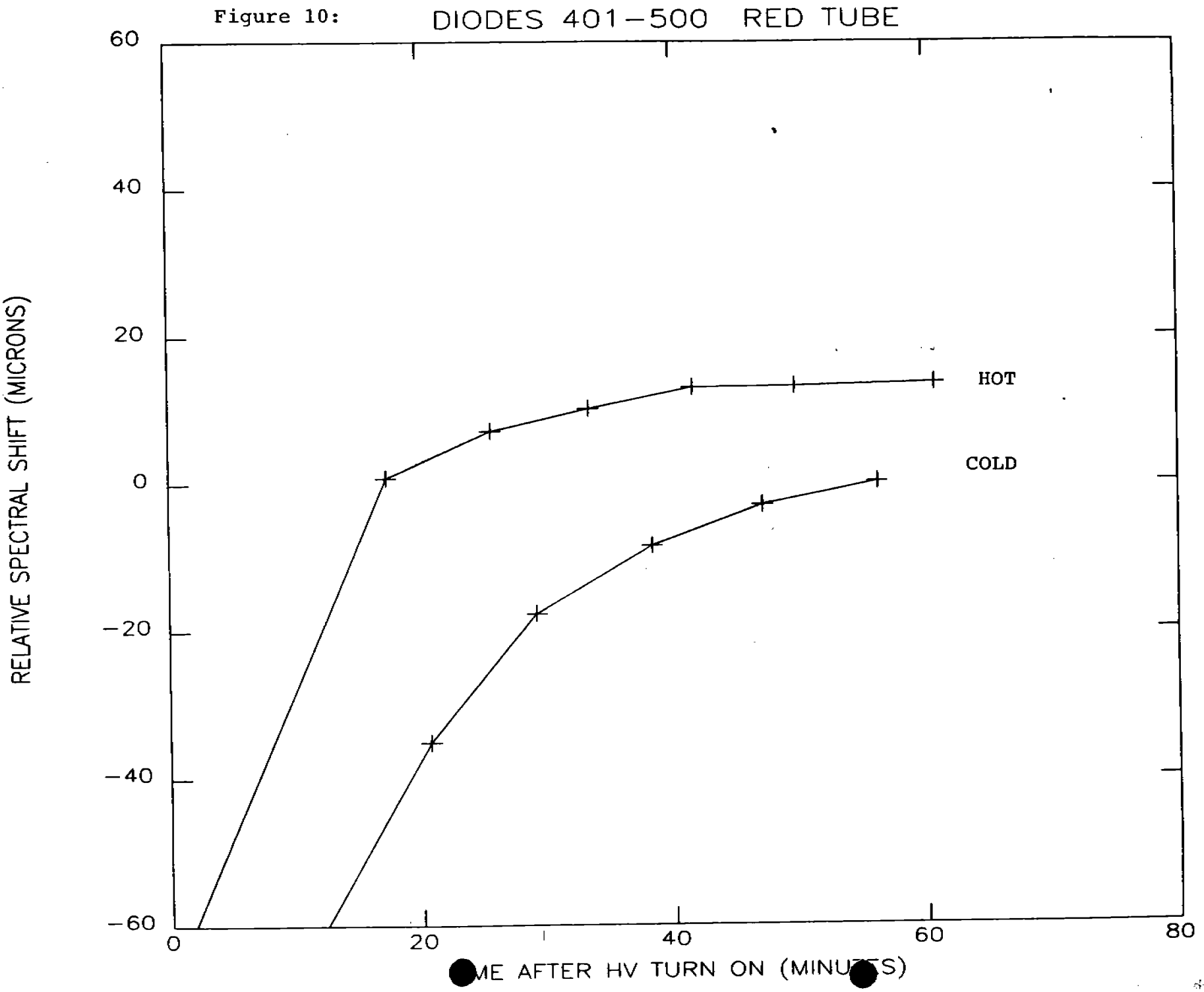
DIODES 401–500 RED TUBE
60
40
20
0
−20
−40
−60
RELATIVE SPECTRAL SHIFT (MICRONS)
HOT
COLD
0
20
40
60
80
ME AFTER HV TURN ON (MINUTES)

Figure 17:

THERMAL STABILITY