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U.S. National Environmental Satellite Center, Washington, D.C.

CHARACTERISTICS OF DIRECT SCANNING RADIOMETER DATA

Supplement I to
National Environmental Satellite Center
Technical Memorandum NESCTM 7
The Improved TIROS Operational Satellite

Edward G. Albert

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National Oceanic and Atmospheric Administration
TIROS Satellites and Satellite Meteorology

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Figure 5 is shown as a mirror image in copies from the first printing. The pictured incoming rays converge towards the detector optical assembly.

Figure 6 is printed upside down.

Page A-2, Appendix, Substitute the following for table in paragraph 2:

Video Amplitude	APT and SR Visible Data	SR IR Data
2.8 volts, peak to peak	White	Cold (185°K)
0.1 volts, peak to peak	Black	Hot (330°K)

CHARACTERISTICS OF DIRECT SCANNING RADIOMETER DATA

NESC TM 7 describes the Improved TIROS (ITOS) satellite. This supplement describes in greater detail the scanning radiometer (SR) data received directly by local APT stations.

Figure 1 shows the signal format and timing relationships for the infrared data channel (top) and the visible data channel (bottom).

The vertical scale is in percent of peak deviation for a detected video signal, not for the amplitude modulated 2400 Hz subcarrier (this presentation has the advantage of allowing greater accuracy in drawing signal amplitudes).

The signals illustrated are divided into 9 segments labeled A through I. Segments A and B represent the 300 Hz synchronization pulse burst and the pre-earth scan of space which are shown in greater detail in Figure 2.

Four hypothetical earth scene responses are shown in the earth scan portion (C, D, E and F) of each signal train. They are illustrative only, not accurate. Segment C might result from viewing a dense Cirrus overcast, a cold, bright surface. Similarly, segment D might result from viewing a cloudless desert, segment E from a cloudless ocean and segment F from an overcast of low clouds.

The signal segment labeled G is ambiguous in the IR channel. If present plans are followed, there will be a "sun shield" for the SR which will enter the field of view just as the scan leaves the earth. The shield will block that view of space and slightly reduce the contrast or detectability of that horizon. If the sun shield should prove unnecessary and be discarded, a view of space will be present instead.

Segment H is a synchronization and calibration signal. It consists of a wide pulse of the full "hot" or white signal level which is set off from other signals by full black or "cold" signal level "porches" and of six equal signal increment steps from the porch level to the opposite signal extreme. These signals are electronically generated and inserted. The signal levels are controlled so that the "stairstep" portion may be used to relate prelaunch radiometer calibration measurements to the signal levels received in flight (see Table 1).

Segment I is the radiometer response when viewing the inside of its housing.

The horizontal scale is time in milliseconds, or angle in degrees, from the "nominal nadir." That is, zero time or angle is taken to be at the center of the earth scan, assuming the spacecraft roll attitude is perfect. Should the spacecraft exhibit a roll error, the earth's horizons will not be equidistant from the nominal nadir.

Figure 2 is an expanded scale illustration showing more detail of the signal timing for the direct SR data synchronization burst and the earth's "first" horizon. This signal segment is shown as the envelope of the amplitude modulated 2400 Hz subcarrier would appear. The synchronization pulses are a burst of seven cycles of a 300 Hz square wave. Note that here, and in the controlled voltage steps provided on the "far" side of the earth scan, the signal sense is inverted between the two data channels.

The earth horizon indicated in the signal as presented is for the nominal spacecraft altitude of 790 nautical miles for zero roll error. The legend indicates horizon positions for other altitudes from 650 NM to 900 NM, also for zero roll error. The graph at the bottom of the figure may be used to convert angles to the time scale used in this figure so that the effect of roll error on the time delay from pulses to first horizon may be seen.

Table 1 lists the nominal values and tolerances for controlled times and signal levels in both channels. The signal levels are expressed as percent of peak signal deviation because the levels may be slightly different for different radiometers. Precise prelaunch calibration values will be available for each instrument system prior to each ITOS launch. The tolerances on those values will be smaller than shown in Table 1 since the design uncertainties related to component selection will have been removed.

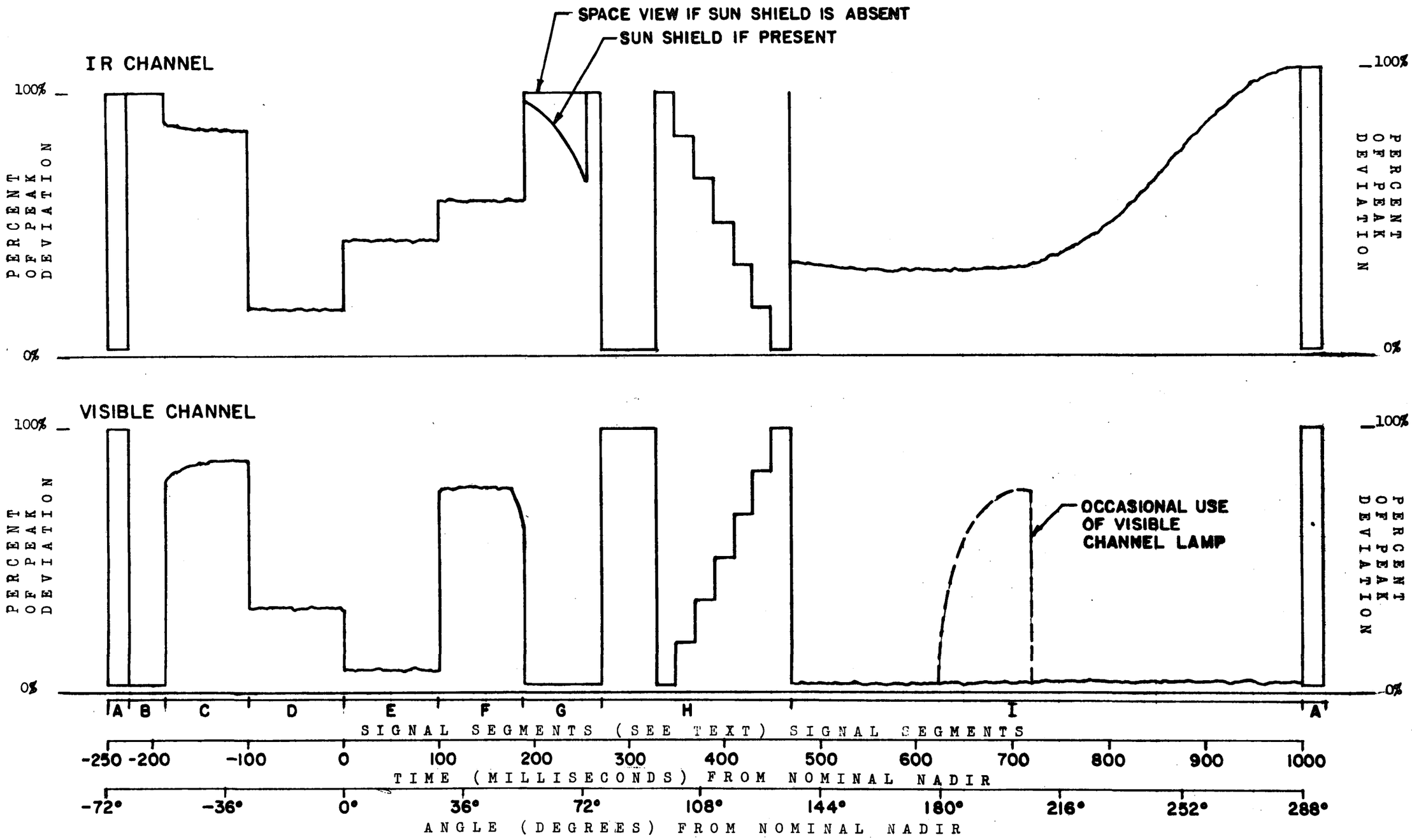
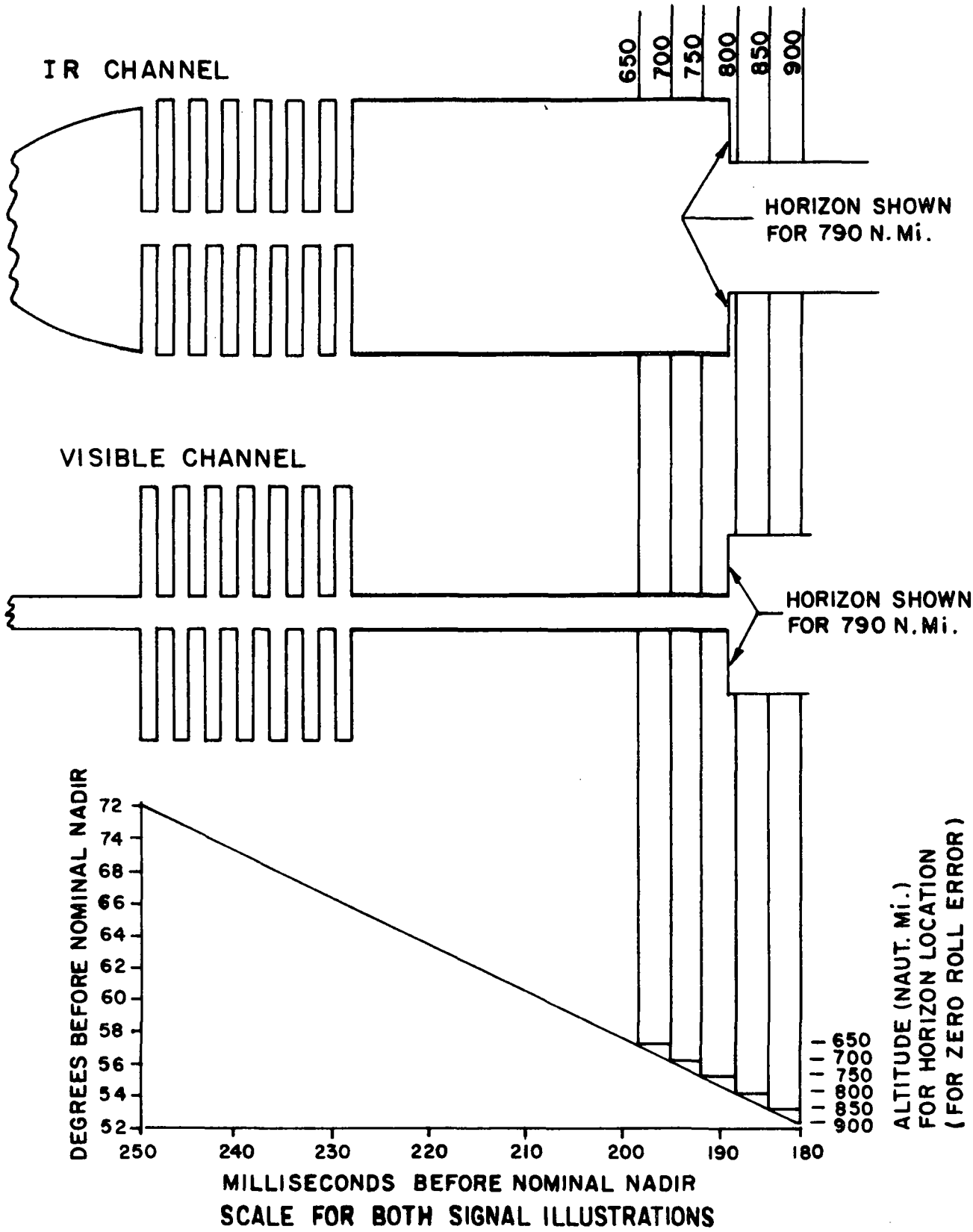


FIGURE 1: DIRECT SCANNING RADIOMETER DATA SIGNAL FORMAT



TIMING DETAIL—DIRECT SR DATA SYNCHRONIZATION BURST AND HORIZON LOCATION

FIGURE 2

Table 1. Two Channel SR Data Controlled Voltage and Timing Values

	IR DATA	VISIBLE CHANNEL
LINE RATE (rpm)	48	48
SPECTRAL INTERVAL (microns)	10.5 - 12.5	.52 - .73
FIELD OF VIEW (milliradians)	5.3	2.7
SIGNAL LEVELS (expressed as percent of peak signal deviation, see text)		
Scene Data		
Black or Hot (330°K) Scene	4	4
White or Cold (185°K) Scene	100	100
Direct Data Synchronization Burst (Segment A)		
Maximum Value	100	100
Minimum Value	4	4
Controlled Levels (Segment H)		
Wide Pulse	4	100
"Porches" of Wide Pulse	100	4
Calibration Step 1	84	20
Calibration Step 2	68	36
Calibration Step 3	52	52
Calibration Step 4	36	68
Calibration Step 5	20	84
Calibration Step 6	4	100
Tolerances	±2	±2
SIGNAL DURATIONS (milliseconds)		
Scene Data		
Single Field of View (a "picture element")	1.05	0.55
Direct Data Synchronization Burst (Segment A)		
Single Pulse	1.67	1.67
Full Burst*	20.0	20.0
First Pulse to Nominal Nadir*	247.7±5	249.4±5
Controlled Levels (Segment H)		
Wide Pulse	60±5	60±5
Steps and Porches	20	20

*Considering transitions from minimum to maximum signal deviation in each channel.