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CHAPTER 9

CLOUD HEIGHT SENSOR (CEILOMETER)

SECTION I. DESCRIPTION AND LEADING PARTICULARS

9.1.1 INTRODUCTION

The ASOS cloud height sensor, hereinafter referred to as the ceilometer, senses and reports cloud levels in the atmosphere. The ceilometer is a VAISALA model CT12K that uses invisible laser radiation to detect cloud levels. The ceilometer basically works by transmitting a pulse of laser light into the atmosphere and sensing the light return as it is reflected back toward the ceilometer by objects in its path. By timing the interval between the transmission and reception, the height of particles (such as water droplets or ice crystals in clouds) above the ceilometer is calculated and reported to the data collection package (DCP). This chapter provides information on the physical description, installation, operation, theory of operation, and both preventive and corrective maintenance for the ceilometer.

9.1.2 PHYSICAL DESCRIPTION

9.1.2.1 **General Description**. The CT12K ceilometer (figure 9.1.1) consists of a single housing assembly mounted on a support pedestal. The pedestal is high enough to provide clearance in deep snow accumulations, and is hinged in the middle to facilitate maintenance. (A quick-release pin secures the hinge plates together.) The cabinet houses the sensor optics and electronics. The equipment cover protects the equipment cabinet assembly from the environment. The top of the equipment cover provides two window openings for the ceilometer optics. A window conditioner is mounted on the top of the equipment cover to protect the windows from dust and precipitation. The warm airflow output by the window conditioner and two internal heaters warm the entire ceilometer during periods of cold temperatures. The physical and operational specifications of the ceilometer are provided in table 9.1.1.

9.1.2.2 **System Components**. The equipment cabinet assembly contains all of the physical system components of the ceilometer (figure 9.1.2), which are divided into two subassemblies: the optics subassembly and the electronics subassembly. The optics subassembly, which contains the optics housing as a frame, consists of a transmitter board, a receiver board, associated optics adjustment hardware, a light monitor board, transmitter and receiver lenses, a temperature compensation transformer, two temperature control heaters, and an optional solar shutter. The optics subassembly is mounted on the electronics subassembly with six screws and is electrically connected using seven separate cables and four attached connectors. The electronics subassembly uses an equipment base, high voltage power supply housing, and board frame as its mechanical structure and consists of a high voltage power supply, processor board, unregulated power supply board, I/O connector board, and fiberoptic module. An external temperature sensor (and snow shield, if required) and the four connectors are mounted to the equipment base and connect to the various internal subassemblies via cables.

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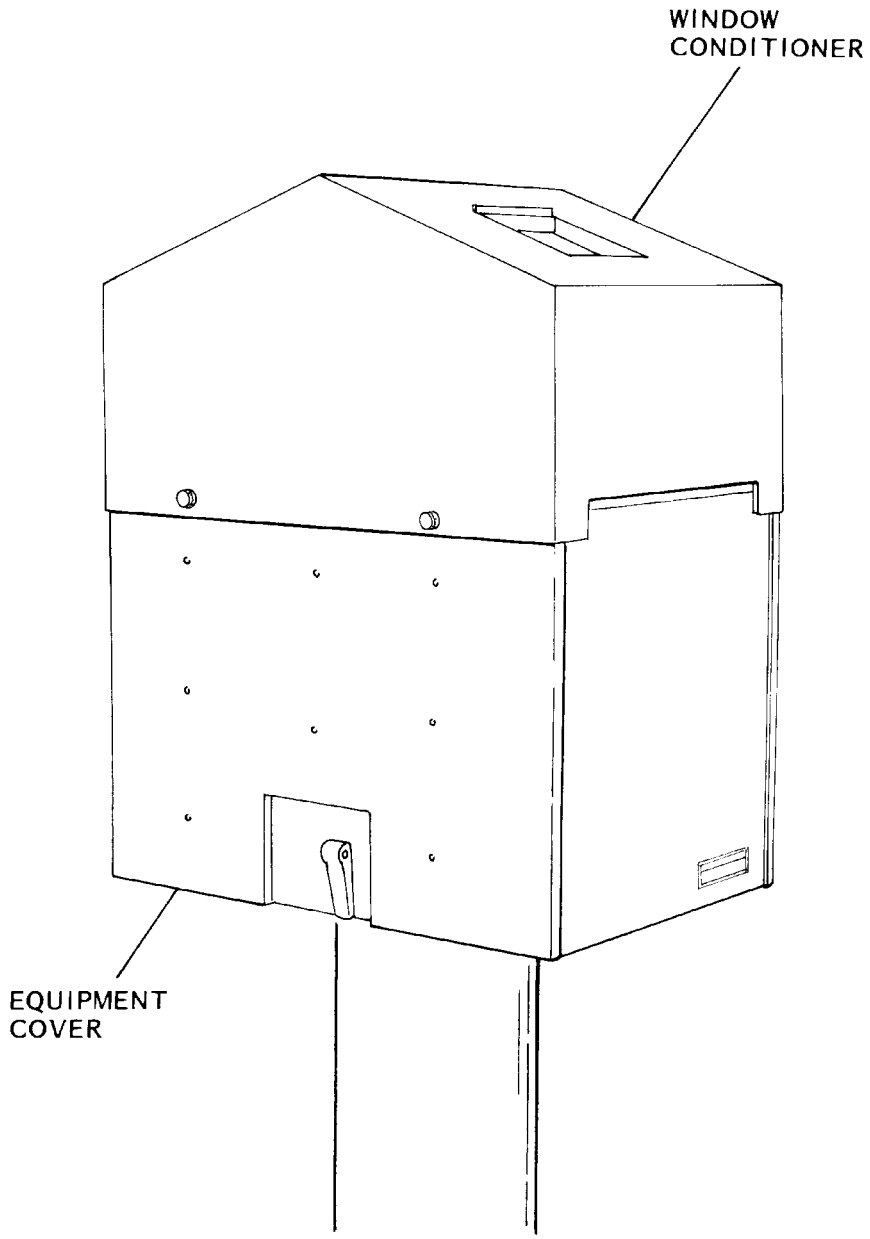

Figure 9.1.1. Ceilometer (CT12K)

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Table 9.1.1. Ceilometer Specifications

Parameter	Specification
PHYSICAL:	
Height	52.8 in. (with pedestal), 29.1 in. (without pedestal)
Width	22.8 in.
Depth	16.5 in.
Weight	156 lb (with pedestal), 135 lb (without pedestal)
ELECTRICAL:	
AC power	116V ±10%, 45 to 65 Hz, 800 watts (7 amperes) max
TRANSMITTER OPTICS:	
Laser source	Gallium Arsenide (GaAs)
Diode wavelength	904 nm nominal
Operating mode	Pulsed
Initial transmitted pulse energy	6.6 microwatts ±5% (factory-adjusted)
Peak pulse power	40 watts (typical)
Pulse width @ 50% peak	135 nanoseconds (typical)
Repetition rate	620 to 1,120 Hz, processor-controlled for constant average power
Average power	5 milliwatts
Maximum irradiance	50 microwatts/cm^2 measured with 7 mm dia aperture
Laser classification	Class I in compliance with FDA CFR 1040.10 (Subsection e,3)
Laser source dimensions	50 mil sq (1.3 x 1.3 mm)
Transmitter optics focal length	14.45 inches (367 mm)
Transmitter effective lens dia	4.65 inches (118 mm)
Transmitter beam divergence	±2.5 mrad maximum
Lens transmittance	90% typical
Window transmittance	97% typical, clean
RECEIVER OPTICS:	
Detector	Silicon Avalanche Photodiode
Responsivity at 904 nm	40 A/W (factory adjustment)
Surface diameter	0.0314 in. (0.8 mm)
Interference filter	904 nm
50% pass band	880 to 940 nm typical
Transmissivity @ 904 nm	85% typical, 60% minimum
Focal length	5.91 inches (150 mm)
Reception lens effective diameter	4.65 in. (118 mm)
Field of view divergence	±2.7 mrad
Lens transmittance	90% typical
Window transmittance	97% typical, clean
OPTICAL SYSTEM:	
Lens distance, transmitter - receiver	12.2 in. (301 mm)
Laser beam, entering receiver field of view	100 feet (30 meters)
Laser beam 90% within receiver field of view	1,000 feet (300 meters)
PERFORMANCE:	
Measurement range	0 to 12,650 feet
Resolution	50 feet
12,000 ft acquisition time	30 seconds maximum
System bandwidth	10 MHZ at low gain (-3 db), 3 MHZ at high gain (-3 db)
Tolerance of precipitation	To 0.3 inch (7.5 mm) per hour, range-limited
ENVIRONMENTAL CONDITIONS:	
Ambient temperature	-60 to +120 degrees F (-51 to +49 degrees C)
Humidity	100% relative humidity
Salt spray	MIL-STD-810C Method 509.1
Wind	100 kt (50 m/s)
Shock	4 inches (10 cm) drop

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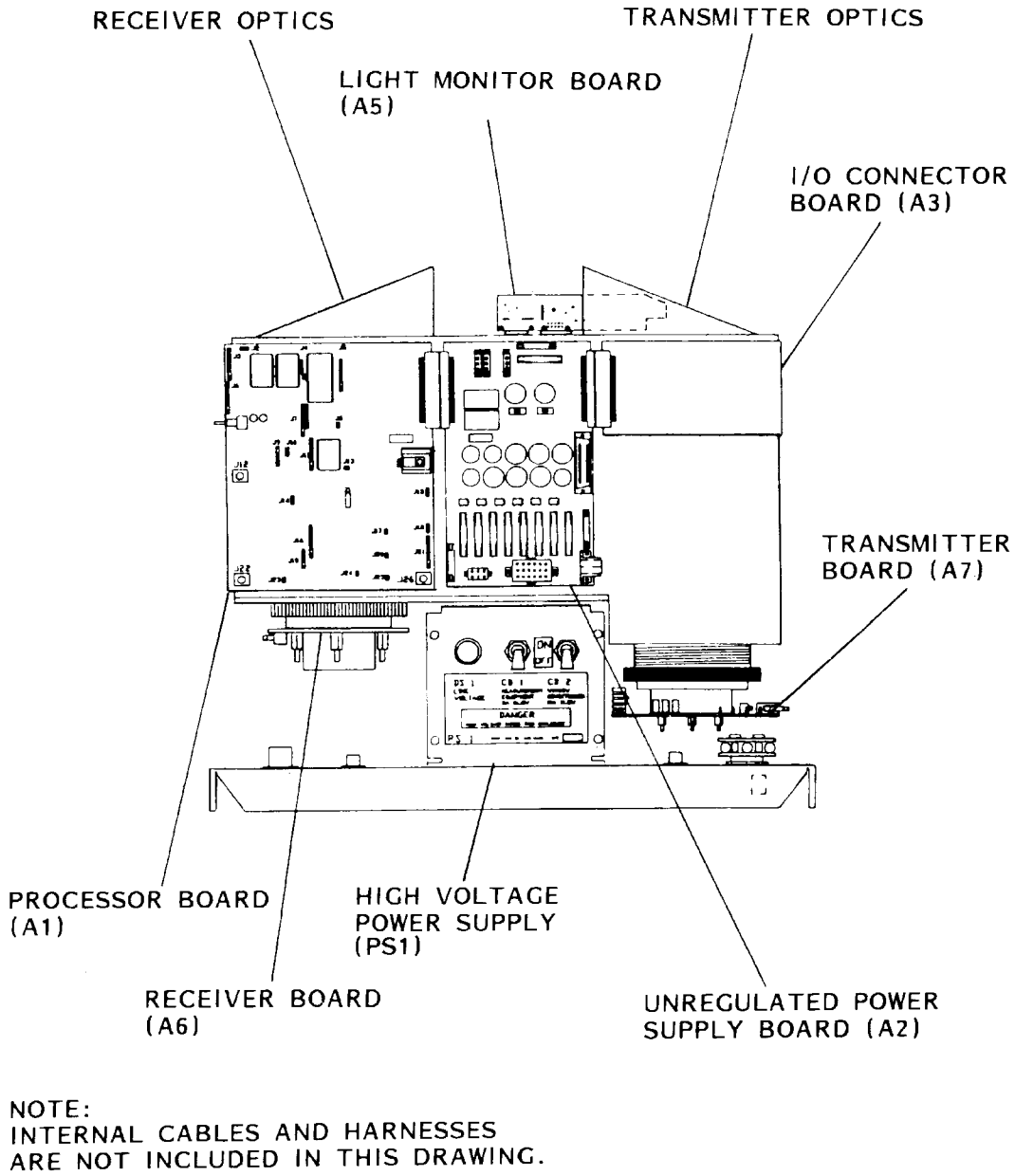

Figure 9.1.2. Ceilometer System Components (Sheet 1 of 3)

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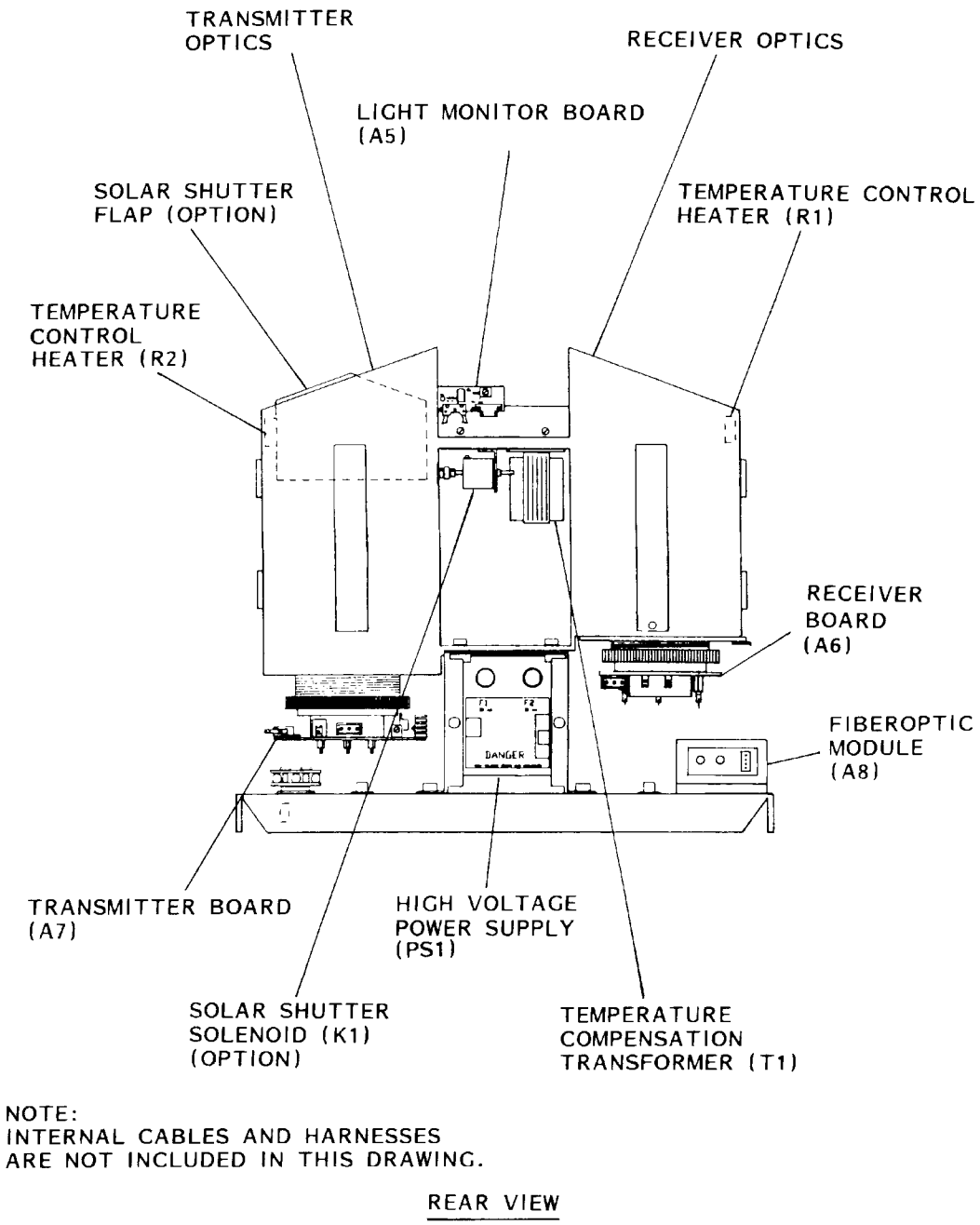

Figure 9.1.2. Ceilometer System Components (Sheet 2)

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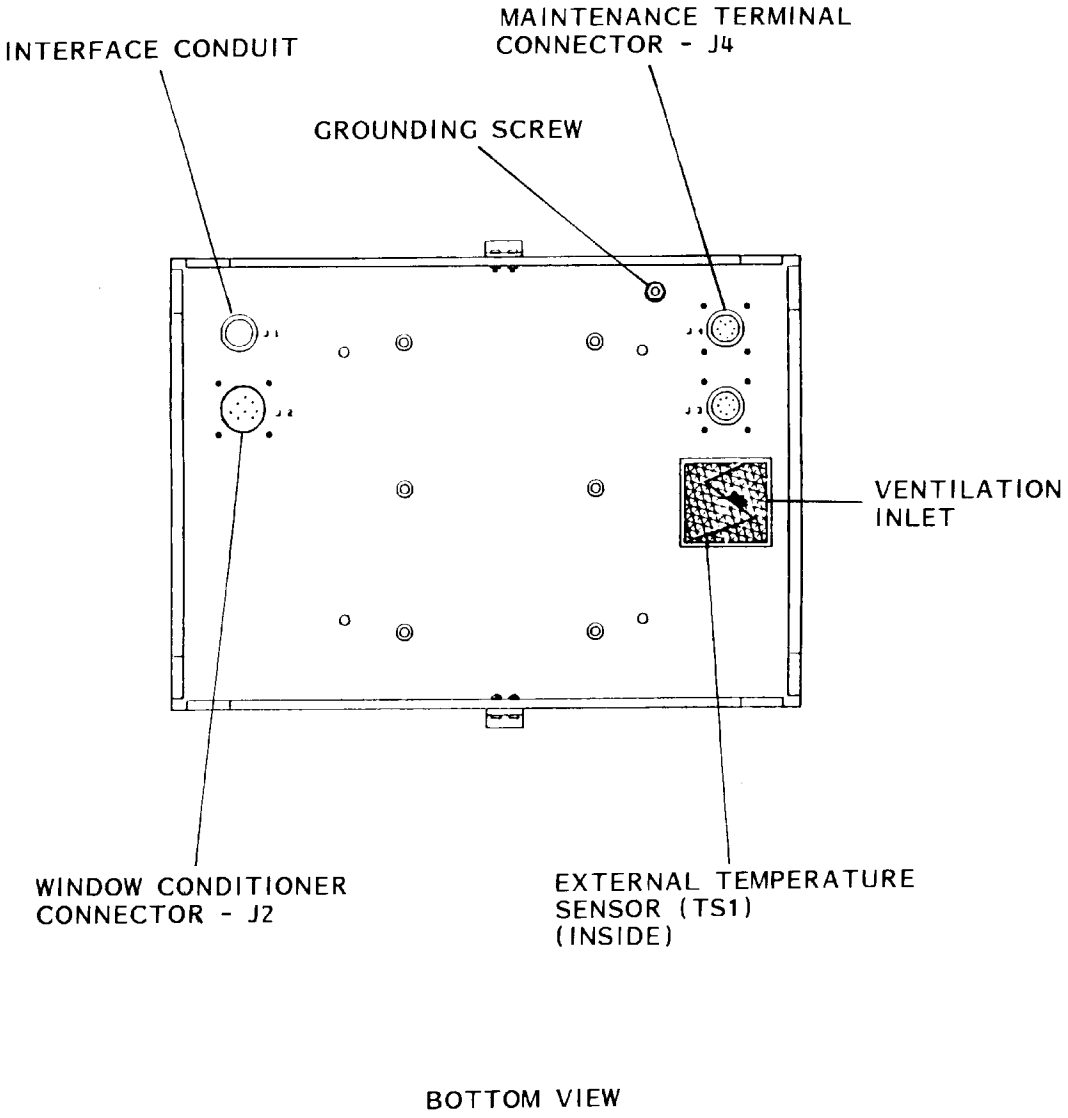

Figure 9.1.2. Ceilometer System Components (Sheet 3)

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9.1.2.3 **Ceilometer Configurations**. Some ceilometers are equipped with a solar shutter assembly on the transmit side of the ceilometer (figure 9.1.2). Solar shutters are installed on ceilometers used in tropical regions from 30 degrees North latitude to 30 degrees South latitude. The shutter protects the transmit laser from damage by direct sunlight. The solar shutter closes over the transmit lens during times when direct sunlight can enter the lens system. Ceilometers equipped with solar shutters are also equipped with tropical receiver assemblies. The tropical receiver assembly has a different filter and mounting block than the filter installed on the standard receiver assembly. The ceilometer is installed in one of four configurations with each configuration assigned a unique part number. (Refer to the Parts List located after the last chapter in volume II.) The part numbers identify the original and refurbished configurations both with and without solar shutters. Original and refurbished configurations with solar shutters are identical as are original and refurbished configurations without solar shutters. Table 9.1.2 identifies the different ceilometer configurations and associated receiver assemblies. Some ceilometers are equipped with a snow radiation shield (part number 50-20663 Rev. H) covering the ambient air temperature sensor on the bottom of the unit. The snow shield prevents sunlight, reflected by snow, from inadvertently causing heating of the temperature sensor. The snow shield will require cleaning each Fall, prior to the winter season. See table 9.5.33 for the snow radiation shield removal and installation procedure.

Table 9.1.2. Ceilometer Configurations

Ceilometer Configuration	Part Number	RCVR Assy Nomenclature	Part No.
Original with no solar shutter	62828-90112-10	Standard	62828-90112-4
Original with solar shutter PN 62828-90112-9	62828-90112-20	Tropical	62828-90112-4
Refurbished - no solar shutter	62828-90112-30	Standard	62828-90112-4
Refurbished - with solar shutter PN 62828-90112-9	62828-90112-40	Tropical	62828-90112-4
Refurbished - with solar shutter PN 62828-90112-9 & tropical filter	62828-90112-50	Tropical	62828-90112-11
Refurbished - with solar shutter PN 62828-90112-9 & tropical filter	62828-90112-60	Tropical	62828-90112-11
Ceilometer FMK#073, Rev A, snow shield installation	50-20663 (CAGEC 65653)		