

## DayCor "Solar Blind" Corona Camera

## DayCor Camera - Background

Corona from high voltage equipment has always been an operational and maintenance problem for electric power utilities. In addition to causing noise and radio interference problems, these luminous discharges, which result from the ionization of air around an electrode, may also indicate the presence of faulty, damaged or contaminated high voltage components. Corona on some types of components can lead to premature aging and failure of that component.

Identifying sources and the exact location of corona during daytime is extremely difficult because it is almost impossible to see corona in the presence of sunlight. Nighttime viewing either from the ground or by helicopter is often difficult, inefficient, and expensive. Other methods to identify corona activity, including listening for audible noise (AN) and measuring radio interference (RI), are affected by background noise and may not easily pinpoint the source of corona.

Because of the limitations in corona detection and location technology, power utilities have only used corona inspections to identify defective components on a very limited basis, mostly to investigate customer complaints of AN or RI.

In 1996, EPRI identified a critical need in the electric power industry for a "solar blind" corona detection and location device. (EPRI was established in 1973 as the Electric Power Research Institute, a non-profit research consortium.) In 1997, EPRI found the key technology needed to develop such a device at Ofil, Ltd. (Ofil is a research, development and manufacturing company in Israel with extensive experience in the development and manufacture of UV filters.) The development of a truly "solar blind" corona detection device, called DayCor, was begun in 1997 as a joint development project of EPRI and Ofil.

The DayCor Mk II camera being offered in this document is a result of this joint development effort. The DayCor Mk II camera is shown in Figure 1.



Figure 1 DayCor Mk II Corona Camera



## How DayCor Works

The DayCor camera solves the problem of viewing corona in the daylight by blocking out the sunlight and then superimposing an image of the corona on an image of the object under investigation. While corona discharges emit ultraviolet (UV) light, principally in the 230 to 405 nm range, the DayCor camera is designed only to detect UV radiation in the 240 to 280 nm range, the so-called UV solar blind band of the spectrum (see Figure 2).



The atmospheric ozone layer absorbs all solar radiation in this band, allowing none to reach the earth. As a result, the DayCor camera can detect corona in bright sunlight. Although corona emissions are weaker in this band than in the overall 230 to 405 nm range, the DayCor camera is able to provide high-quality, high-contrast images due to the complete absence of background radiation. The key to the camera's ability to produce such images is its UV solar blind bandpass filter, which is installed in front of a UV image intensifier. Corona discharges can be observed in the daylight by placing a solar blind bandpass filter in front of a UV image intensifier, but it is impossible to determine the exact location of the activity without the ability to overlay the image of the corona over an image of the component under scrutiny. To solve this problem, the DayCor camera employs bi-spectral imaging. It utilizes a UV beam splitter to divide the incoming image into two images (see Figure 3).





Figure 3 The DayCor utilizes bi-spectral

One image is sent through the solar blind filter, which eliminates sunlight, then through an image intensifier and a charge coupled device (CCD) camera. The other image is sent through a standard video camera. The two images are then processed and combined in an image mixer. An example of the actual image produced is presented below (see Figure 4). Upon closer visual inspection, broken strands on the conductor were found (see Figure 5).



Figure 4 DayCor image of corona



Figure 5 Visual close-up of a broken strand on a transmission line

# DayCor Mk II Camera Characteristics

The DayCor corona camera can be used either from the ground or from the air to find corona in full sunlight. DayCor camera is unique in its ability to detect and display the exact location of corona during the daytime, totally unaffected by sunlight.



The DayCor Mk II camera package includes both analog filtering and digital signal processing (DSP) cards; built in LCD monitor; DSP and camera batteries with charger; carrying vest for the camera; backpack for the batteries and DSP; and a hard case for camera and accessories.

The DayCor Mk II camera provides the user a number of features and options to help the user find and assess corona. The user may select the combined UV and visible image, UV only image or visible image only. The corona intensity option activates the DSP to provide the user with a real-time measure of the intensity of the corona (photons per minute). The corona alarm option activates the DSP to provide the user with a visual alarm when corona is present in the camera field of view.



< Corona Intensity

Corona Alarm >



# Specifications for the DayCor Mk II Camera

UV Camera	Three-stage image intensifier with UV
	advanced solar-blind photo-cathode
Visible camera	High-sensitivity color camera with zoom lens,
	auto focus and digital interface
Lens UV	_f=165F4
Lens Visible	18x zoom f-4.1 to 73.8
Field-of-view	_5° (horizontal) x 3.75° (vertical)
Focus range	UV: 3m to infinity Visible: 0.8m to infinity
Focus method	_Automatic or manual focus of visible camera;
	UV camera focus slaved to visible focus
Zoom	The zoom of the visible lens is preset to give
	the same FOV as the UV lens
Sensitivity	_300pC @ 50m
Image Overlay Registration	_< 50 mm at 50 m (1 miliradian)
Image rate	Standard 30 frames/sec
Video Overlay	Analog video keying or digital video overlay
Output Type	_NTSC & PAL (Color combined image)
Built-in Display	LCD Black & White Screen



Display Modes	Combined UV-visible overlaid image
	UV only Visible only
Noise Suppression	Digital signal processing
	_Digital Signal processing.
Corona alarm	_visual indication of corona presence
Environmental	_Solar blind
	Operation temperature range: $-25^{\circ}$ C to $+55^{\circ}$ C.
Dimensions (L x W x H)	_Camera: 255 x 180 x 180 mm (10" x 7" x 7")
Weight	Camera: 5.5 kg (12 lbs.)
0	Backpack with batteries & DSP: 3.5 kg (8 lbs.)
	Total: 9.0 kg (20 lbs.)
Camera Power Supply	12 VDC (Battery and AC to DC converter
	included)
DSP Power Supply	12 VDC (Battery and AC to DC converter
	included)
Camera Controls	
Power: On/Off	
Display Modes:	
<ul> <li>Inormal (combined UV)</li> </ul>	and visible overlay),

- UV only, and
- Visible only

UV Camera Gain (for image optimization) Auto/Manual focus Processing: Analog/DSP Status display Visible camera zoom Visible exposure

As an extra cost option, we offer a DayCor Field Recording Accessory Package. This package lets the user record DayCor images and voice messages in the field. The recording accessory package includes one digital recording device, one mini tie-clip microphone, one microphone amplifier, one remote control unit, and required cables and connectors. We can provide details on request.

## <u>Availability</u>

The DayCor Mk II camera is marketed and sold by EPRIsolutions. (EPRIsolutions is a wholly owned subsidiary of EPRI and was formed in 2000 to market, sell and support EPRI developed products and technology.)

Current delivery of the DayCor Mk II camera is within 90 to 120 days of receipt of a purchase order. Delivery times may vary with the number of cameras ordered.

Ofil, Ltd. in Nes Ziona, Israel, manufactures the DayCor Mk II camera.



A variation of the DayCor Mk II camera, called the DayCor Mk IIa, is also available.

Both Mk II series cameras are identical except for one item. The Mk IIa camera does not have the Digital Signal Processing (DSP) card that is included in the Mk II camera. Deleting the DSP card changes the screen "cleanup" (random noise reduction) processing in the camera to an analog process, eliminates the automatic corona identification (corona "targeting") feature and eliminates the corona intensity measuring (photon counting) feature. All other features are the same for the MK II and MK IIa models.

The Mk II model camera package includes both analog filtering and digital signal processing (DSP) cards; built in LCD monitor; DSP and camera batteries with charger; carrying vest for the camera; backpack for the batteries and DSP; and a hard case for the camera.

The Mk IIa camera package includes the analog filtering card; built in LCD monitor; camera battery with charger; carrying vest for the camera; backpack for the camera battery; and a hard case for the camera.

We offer the following training options:

- Scheduled training classes at our Lenox Massachusetts Center
- On-site training in your offices

### <u>Warranty</u>

The manufacturer warranties the DayCor Mk II package including camera, DSP (Digital Signal Processor), backpack and cables, to be free from defects in workmanship, material and components for a period of 12 months under normal use and service. Batteries are not included in this warranty period.

### **Contact**

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