INSTRUCTIONS FOR THE OPERATION AND MAINTENANCE OF THE OCEAN IMAGING SYSTEMS, 2,000 METER, ALUMINUM MODEL DSC-12000 DIGITAL STILL CAMERA

M-12000-002

S/N 002

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1.0 INTRODUCTION

The DSC 12000 digital still camera described in this manual features a 2,000 meter aluminum housing and a 12.9 megapixel sensor. This camera has been supplied with a special 50mm lens. The specifications are outlined below:

1.1 SPECIFICATIONS

Weight in air:	9.0 kg (20.0 pounds)
Weight in water:	3.3 kg (7.3 pounds)
Length:	22.9 cm (9.0 inches)
Diameter:	19.0 cm (7.5 inches)
Housing Material:	6061-T6 Aluminum
Connectors:	Impulse, MCBH(WB)-8-MP,SS, Interconnect to strobe
	Impulse, MCBH(WB)-6-MP,SS, USB
	Impulse, MCBH(WB)-4-MP,SS, RS-232
Mating Connectors:	Impulse, MCIL-8-FS w/DCDLS-F
	Impulse, MCBH-6-FS
	Impulse, MCIL-4-FS
Power:	External 28 VDC ± 5 VDC
Depth Rating:	2,000 meters
Resolution:	4288 x 2848 Maximum (12.9 megapixel)
Storage:	4 Gbyte SD Card (~ 1,000 images JPEG Norm)
Lens:	Nikkor 50mm f1.4D lens, behind a flat optical port
Field of view:	13.7°(v) x 20.4°(h) (estimate)
Sensitivity:	ISO 200 – 3200
File Formats:	JPEG Fine, Normal, Basic, RAW (NEF), NEF+JPEG Basic
Aperture:	f/1.4-f/16
Control Port:	RS-232, 9600 baud, N.8,1
Download Port:	USB 2.0
Initial Delay:	0 – 65,534 Minutes
Picture Interval:	20 – 65,534 Seconds, or 1 – 65,534 Minutes

1.2 UNDERWATER CONNECTOR PIN ASSIGNMENTS

Pin assignments for the 6 pin USB connector are:

Pin 1: Common
Pin 2: USB +
Pin 3: USB -
Pin 4: USB Power
Pin 5: External Power (+24vdc)
Pin 6: External Power Ground

Pin Assignments for the 4 pin RS-232 connector are:

Pin 1: Power Common
Pin 2: Receive Data (from computer)
Pin 3: Transmit Data (to computer)
Pin 4: External Power (+24vdc)

Pin Assignments for the 8 pin INTERCONNECT connector are:

Pin 1: Power Common
Pin 2: Power Input (+23 to +33 vdc)
Pin 3: Strobe Enable Output To Strobe (28 vdc)
Pin 4: Sync To Strobe (triggers flash)
Pin 5: External Trigger
Pin 6: n/c
Pin 7: n/c
Pin 8: n/c

2.0 OPERATION

The DSC 12000 is a digital still camera based on the Nikon D90 digital SLR (Single Lens Reflex) camera. As such, a through understanding of the D90 is required to operate this camera. Please refer to the D90 manual for detailed descriptions of the camera menu system, operation and optional settings.

CAUTION: Be sure that ALL connectors are properly mated before deployment. Unused connectors, on the camera housing, strobe housing and in the harness should have the supplied dummy connectors installed.

Operation and setup of the camera is described in the following sections.

2.1 CAMERA INSTALLATION

For safety, the DSC 12000 camera is shipped with the D90 removed. The following describes camera installation. If the D90 has been left with the battery removed for some time (or is a new camera), it will be necessary to install the standard (charged) Nikon battery and allow it to

recharge the internal battery that runs the real time clock. Allow the camera to set for 3 days with a charged Nikon battery installed (see D90 manual page 103 for details). When not in use, remove the D90 from the DSC 12000 chassis and install a charged Nikon battery. Once the internal battery has been allowed to charge up the clock battery, remove the Nikon battery.

NOTE: Make sure that the time is set on the camera. A new camera will show that it's clock needs setting when first powered up. The camera will NOT operate until the clock it set.

First, attach the 20mm lens to the D90 body. Make sure:

a) The D70 focus mode is set to MANUAL FOCUS (see D90 manual pages 2 and 32)
b) The camera Mode Dial is set to MANUAL (see D90 manual pages 2 and 50)
c) The standard Nikon battery has been removed
d) The shutter speed has been set to 1/60 sec. or as desired (see D90 manual page 50)
e) The FOCUS must be manually set to the desired setting. Set the focus to the actual underwater distance desired x .75. This multiplier accounts for the change in apparent distance that occurs when a lens with a flat port is immersed in water. Thus if the subject distance is to be 10 feet, set the focus ring to 7-1/2 feet. **Note that the focus can only be set with the camera removed from the camera chassis**. Tape the focus ring with a short length of electrical tape to prevent it from accidentally being moved.

Figure 2.1

Setting Focus

Once installed in the chassis, the focus setting can still be verified.

Figure 2.2

Verifying Focus

f) Other camera settings can be set and changed using "Nikon Control", after the camera has been installed in the chassis, and may change with the specific application.

Open the camera housing by unclamping the two Neilson clamps. Place the clamps in front of the clamp bracket and use the clamp to jack the housing open, as shown in 2.3 below.

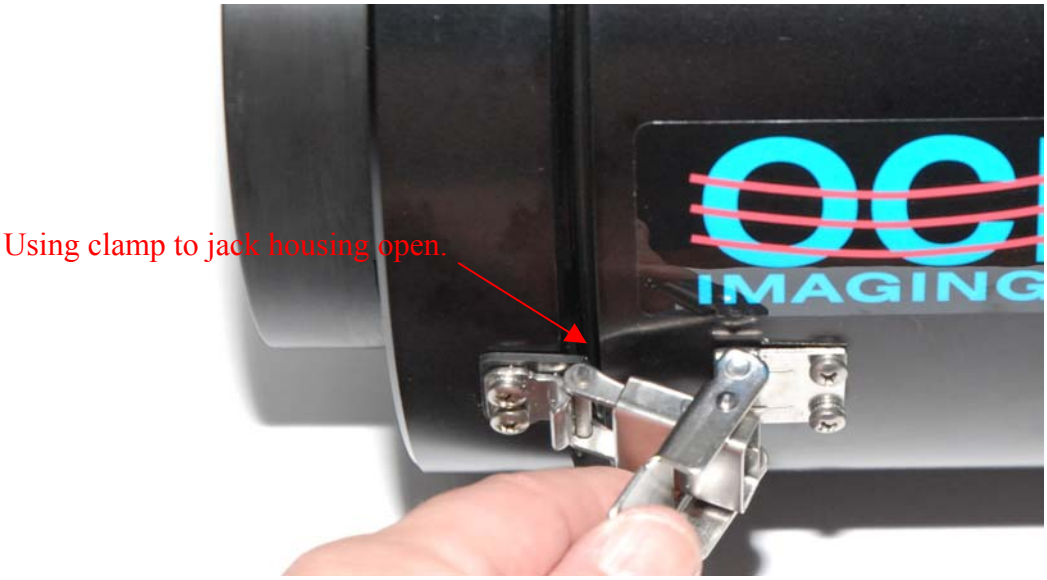


Figure 2.3

Using clamp to open housing

Slide the housing off the endcap, being careful not to pull on the connector wires. Lay the housing down next to the endcap. Disconnect the cables going to the underwater connectors and remove the retaining screw.

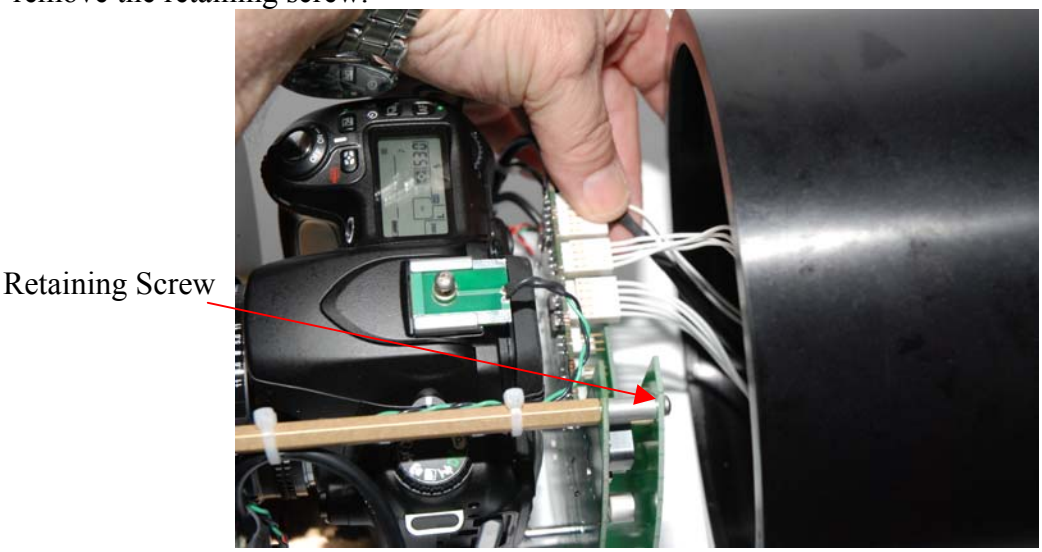


Figure 2.4 Housing Opened

Swing the PC Board up to gain access to the camera mounting area. Install the battery block into the camera, and then install the camera into the chassis. Make sure that the alignment pin engages the D90 body properly. Retain with the plastic ¼-20 screw (installing **hand tight** only) and locking gently with the lock nut.

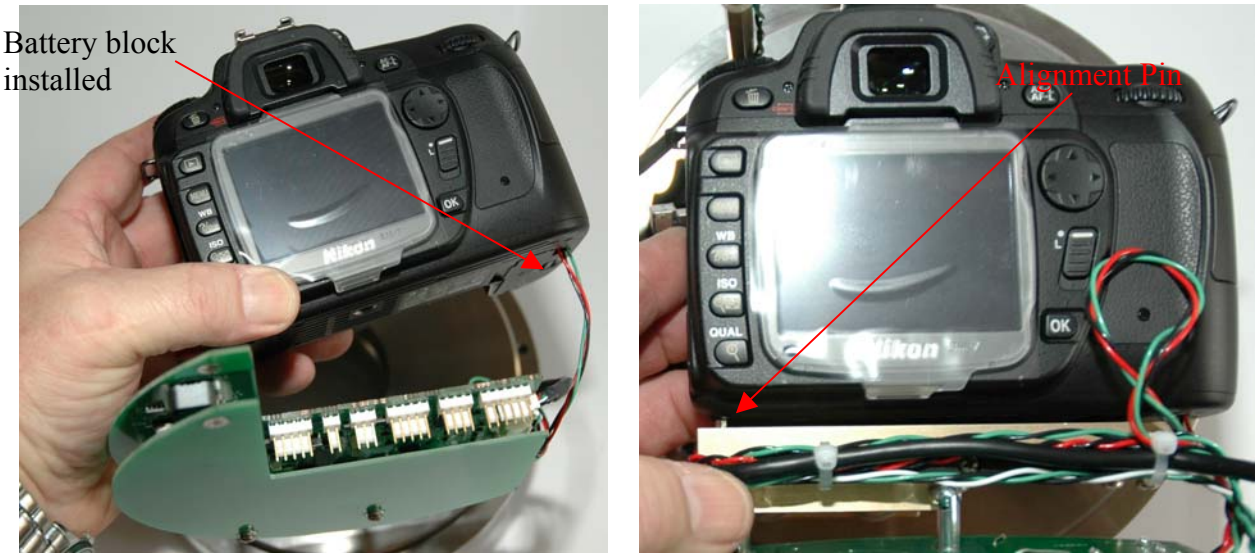


Figure 2.5 Installing Battery Block and D90

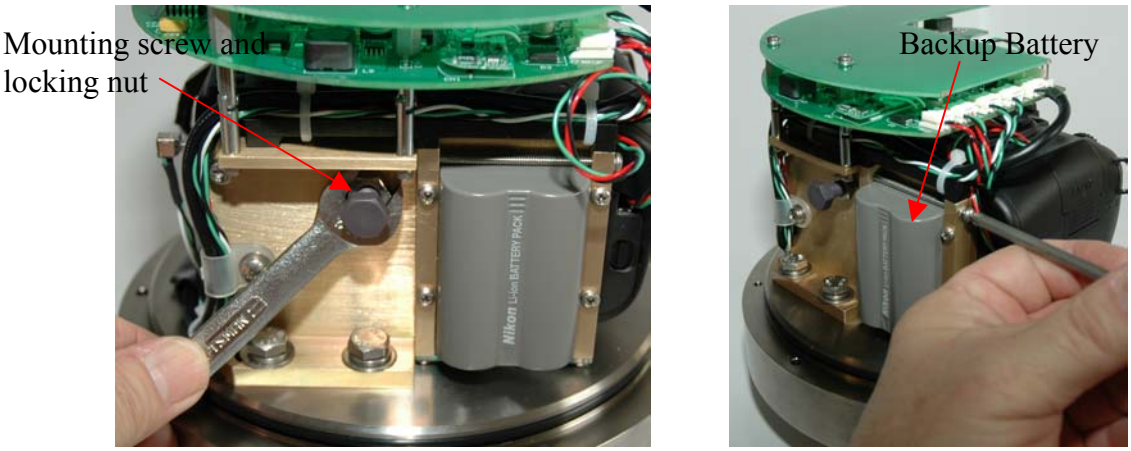


Figure 2.6 Camera Installed and Installing Backup Battery

With the D90 TURNED OFF … install the backup battery and retain with the screw. Make sure that the backup battery has been fully charged before installation.

The backup battery (the standard EN-EL3e battery that come with the D90) powers the D90 whenever external power is removed from the camera (system turned off). No power is taken from this battery when the system is actually turned on and being used in the system. Nikon does not recommend turning the camera power off with the D90 switch turned on (see Nikon manual page 127), which can not be avoided when the housing is closed. Thus this battery thus provides power when the system is off and the D90 is on.

Next install the Sync board into the hot shoe socket of the D90 and secure by gently tightening the screw. Tighten so that the screws are making good electrical contact with the hot shoe without causing damage to the contacts.

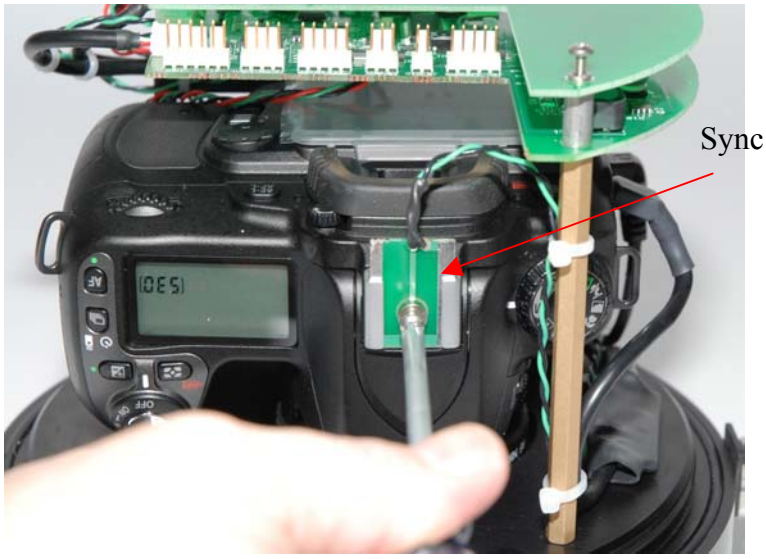


Figure 2.7 Installing Sync Board

Finally, plug in the trigger connector and USB connector into their respective sockets on the side of the D90. At this time make sure the SD memory storage card has been installed in the D90. Now, swing the PC board back down and install the retaining screw and spacer.

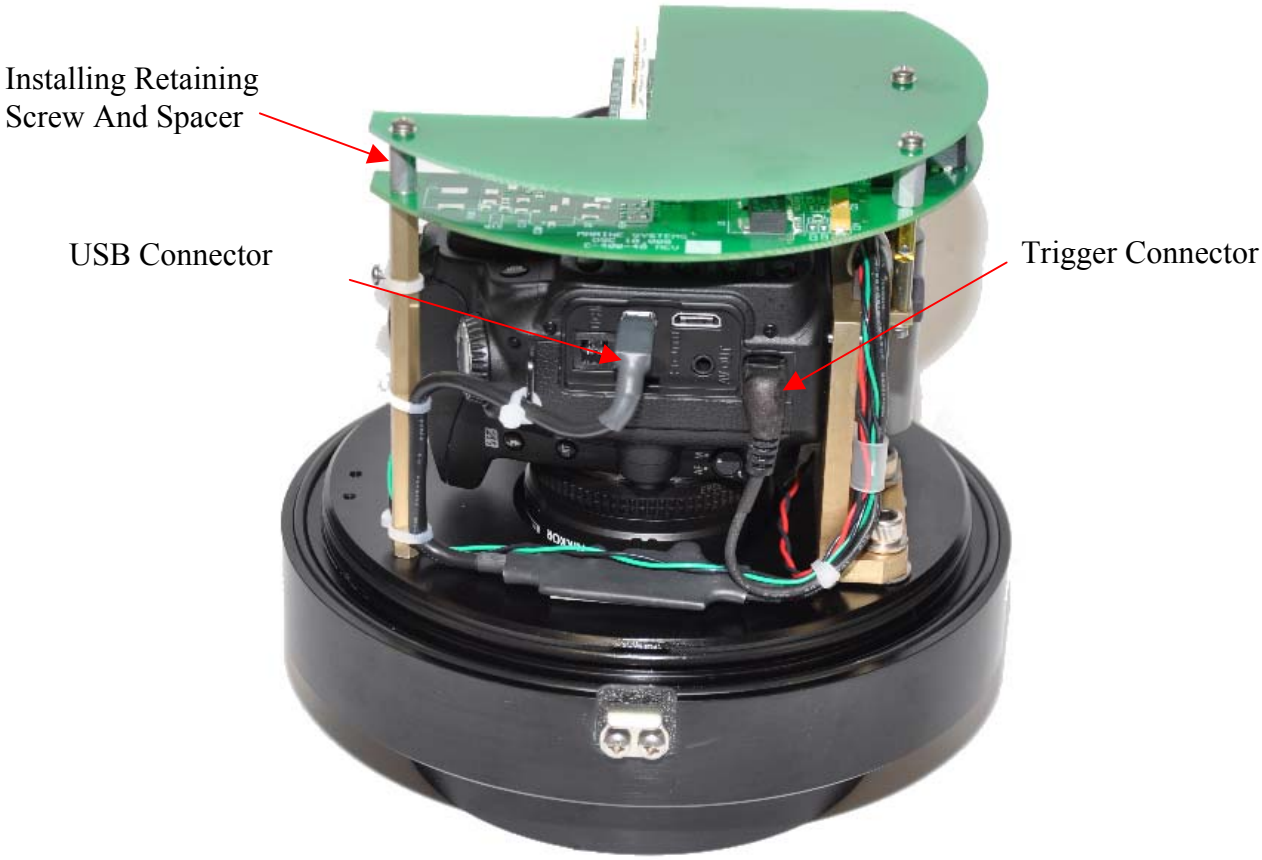


Figure 2.8 USB and Trigger Connectors Installed

Once the camera has been installed, and all the cables connected and secured, turn the D90 ON. Verify that the camera has powered up properly. The LCD display should look generally like the picture below.

Figure 2.9 D90 LCD Display

Reconnect the underwater cables, and the camera should be functional (the housing can be closed, or left open for preliminary testing. See system setup below.

2.2 SYSTEM SETUP MODE

This mode of operation is used to setup the DSC12,000 for the desired system operation. In this mode, all system functions are set, including the delay time and the picture interval.

To operate in setup mode, connect the RS-232 cable (A-400-72) to the 4 pin connector on the camera. Connect the DB-9 connector to a computer running a monitor program (Hyperterm, ProComm etc), and apply power to the modular power supply. Note that the modular supply is a universal type and will operate from any voltage from 100 to 240 vac 50 or 60 hz. Also note that the terminal program should be set to 9600 baud, 8,N,1. Terminal emulation should be set to VT100. If the camera is connected to the strobe, the power switch on the strobe must be TURNED OFF.

Model 12,000, Rear View

Figure 2-10

Upon power up, the microprocessor in the camera determines that there is an operator connected to the RS-232 connector and displays the opening screen below. The screen below is showing a situation where the operator has previously selected 30 second intervelometer operation.

NOTE: For SMAST, the camera has been set for EXTERNAL trigger with FAST response and should not need to be changed.

```
Ocean Imaging Systems - DSC 12,000 - A-400-87 (NOAA) Rev: - 9/10/09
*********************************************************************
****************** Autonomus Camera Settings  ***********************
*********************************************************************
Delay (Minutes):                  0
Trigger Mode:         Intervalometer
Interval (Seconds):              30

*********************************************************************
****************** Immediate Camera Commands  ***********************
*********************************************************************
[C]hange Autonomous Settings:    [C]
Take a [P]icture:                [P]
[S]Trobe Toggle - Strobe is: OFF [S]

Enter Command:                          Press "C" to change camera settings
```

Opening Screen

Figure 2-11

The immediate commands, [S]trobe toggle and [P]icture are only used for system testing and would not normally be used by the operator. The [C]hange Autonomous settings command is used to setup the camera system for the desired mode of operation. If [C] is pressed, the screen below is shown.

```
*********************************************************************
******************** Change Camera Settings  ************************
*********************************************************************
Enter Inital Delay Between 0 And 65534 Minutes:  enter desired delay time
```

a) ***Delay Time*** – You will be first prompted to enter the Initial Delay. This is the time (in minutes) from system turn on until normal operation begins and is normally used to prevent pictures from being taken during deployment. A setting of 0 disables this function.

```
Enter Trigger Mode - [E]xternal Trigger or [I]ntervalometer: enter E or I
```

b) ***Trigger Mode*** – After entering the delay time, you will be prompted to enter the trigger mode. There are two basic trigger options. [E]xternal trigger, where the system takes pictures upon an

external switch closure, or [I]ntervelometer mode where the system works autonomously, taking pictures at a fixed interval.

```
Enter Interval Timing Mode - [M]inutes or [S]econds: enter M or S
```

c) ***Interval Mode*** **-** If [I]ntervelometer mode is selected, you will be prompted to choose between [M]inutes and [S]seconds mode. [M]inutes mode is more power efficient as the system is shut down between pictures and only powered up to take a picture. If pictures are to be taken quickly, the system is always powered up.

```
Enter Interval Between 20 And 65534 Seconds: enter interval in seconds
```

```
If [S]econds mode is selected you will be asked to enter your interval in
seconds.
```

```
Enter Interval Between 1 And 65534 Minutes:  enter interval in minutes
```

```
If [M]inutes mode is selected you will be asked to enter the desired interval
in minutes.
```

c) ***External Trigger*** **–** If [E]xternal trigger mode is selected in b) above, you will again have two choices.

```
Enter Trigger Speed - [F]ast or [S]low:          enter trigger speed
```

If a [F]ast trigger speed is selected, the camera and strobe are help ready for an almost instantaneous picture. A switch closure will cause a picture to be taken within approximately 1/8 of a second. This mode is used for bottom contact trigger or ROV/manned submersible applications where a delay between the trigger and the picture are not acceptable.

The down side of this mode is that the camera and strobe are always drawing power. Thus this mode is NOT used were power consumption is an issue.

The [S] trigger speed leaves the system in a powered down state and upon a trigger input will "wake" the strobe up, wait for it to charge (30 seconds) and then take the picture. This mode is used where power conservation is an issue as the system draws less than 250 ua while waiting for a trigger.

2.3 CAMERA SETUP

In addition to setting the system controller functions above, the D90 itself must also be set up. A through review of the D90 manual is required before determining the best settings for a specific application. If the user has the optional Nikon Camera Control Pro software, most camera settings can be set via the USB port, with the camera housing closed. The ***focus is an exception to this***, and must be set before closing the housing. Set the focus as described in section 2.1 paragraph e.

If the user does not have access to Nikon Camera Control Pro, then all D90 settings must be made before closing the housing. The PC Board can be flipped up (see figure 2.5) and the desired settings made with the D90 controls (see D90 Manual).

The following is a starting point for setting up the D90:

Focus mode:	manual
Camera mode:	manual
Aperture:	See 2.3.1 below
Shutter:	1/60 sec
White Balance:	set to “Flash”
Image quality:	JPEG Norm (For >1K image w/4G SD card)
Resolution:	Large
ISO:	200 (or as required for proper exposure)
Image sharpening:	set to “high”
Monitor Off:	5 seconds (Custom Setting Menu)
Meter Off:	4 seconds (Custom Setting Menu)
Image Review:	Off (Custom Setting Menu)

Note: The last two item are done to conserve power. They represent the minimums that can be chosen.

2.3.1 PROPER IMAGE EXPOSURE

The image exposure is the one element that is very specific to the operating environment of the system. As most systems are illuminated solely by a flash, the shutter speed has little if any effect on exposure. Thus the two parameters that the operator can change in the DSC 12000 that effect exposure are the ASA and the aperture. Lower ASA settings yield less noise in the image, and thus are preferred over higher settings. It is suggested that an ASA of 200 be used whenever possible.

The proper aperture can be approximated from the following chart (figure 2-12). As an example, lets assume coastal water and a range of 8 feet. The lens focus should be set to 6 feet (8’ x .75, see section 2.1 paragraph e). By looking at the graph below we see that the “Z” factor is equal to approximately 25. Assuming a 200 watt-second strobe, and an ASA (ISO) of 200, the equation for aperture yields:

$Z = 1.6\ (ASA \times WS)^{-2}/\text{f-stop}$, or this equation can be re-written in terms of aperture (f-stop):

$\text{f-stop} = 1.6\ (ASA \times WS)^{-2}/Z$, for the example given above:

$\text{f-stop} = 1.6\ (400 \times 200)^{-2}/Z$, yielding:

f-stop = 12.8

This very rough estimate would suggest starting with an f-stop of f11 (closest setting to f12.8). Specific water conditions, reflector beam and camera to flash geometry will all effect the image exposure, thus empirical adjustment may well be needed to achieve optimal exposure.

One basic concept in underwater photography that will help yield good results is too separate the camera and flash by as great a distance as possible. Doing this will minimize "back scatter" from particles in the water. Practical considerations usually limit the extent to which the flash and camera can be separated, but making an effort to maximize the separation will pay dividends in image quality.

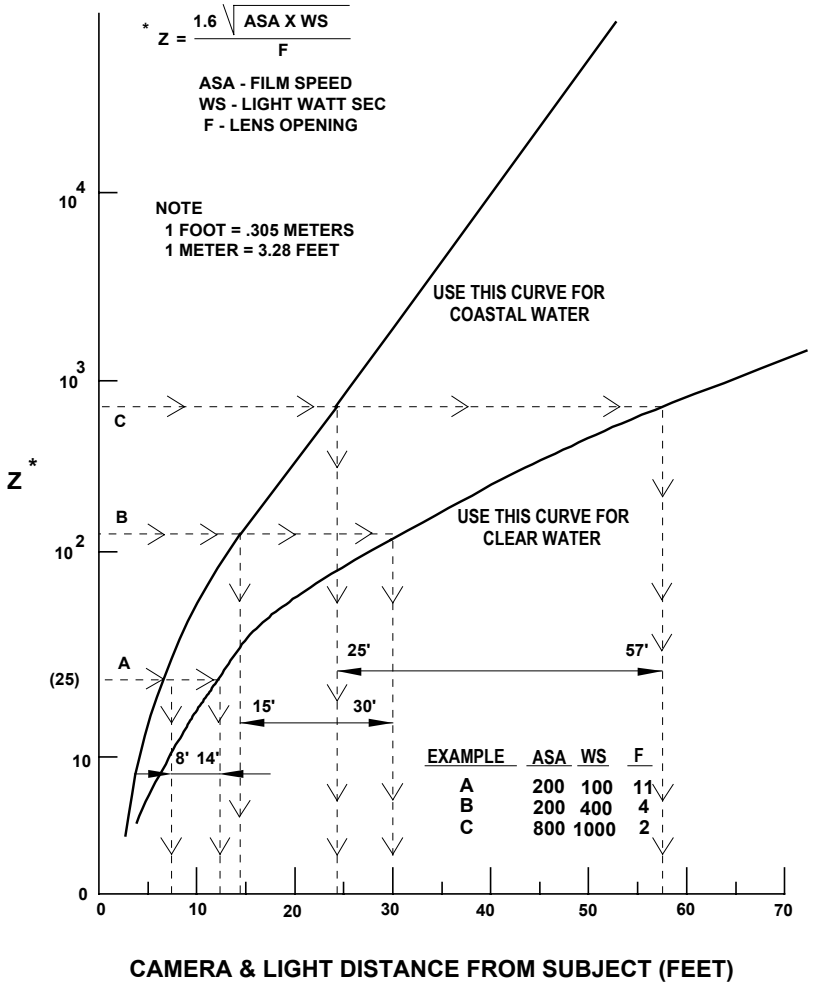
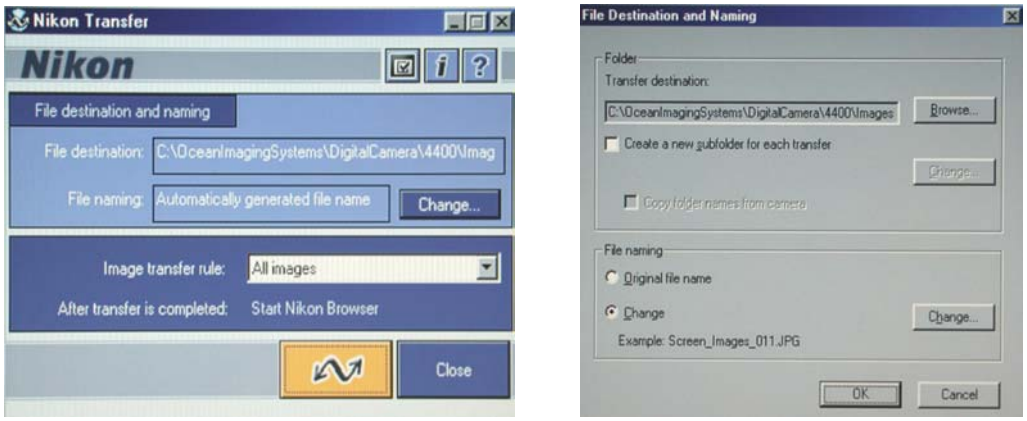


Figure 2-12 Suggested In-Water Exposure Guide

2.4 DATA DOWNLOAD

Once the system has been recovered, the stored images should be downloaded. Turn system power off and connect the USB cable (A-400-73) to the 6 pin connector. Apply power to the power supply module. Then plug the USB connector into a computer that has the Nikon View software installed and is running Windows XP. For this mode, there is no reason to connect the RS-232 cable. The camera should sense the connection to the USB connector and automatically enter USB mode. (make sure to turn off the normal power source, via the 3831 ON/OFF switch. If the software is installed and operating on the host computer properly, the Nikon application should automatically be launched. The screen images below show the what the opening Nikon screen should look like.



Nikon Transfer Software Screen Images

Figure 2-7

See the Nikon documentation for help in installing, operating and troubleshooting the Nikon software. Other software products may be used to download images. It is recommended that the software chosen be tested with the D90 outside the DSC 12,000 and connected with it's standard Nikon USB cable. In this way, the user can become familiar with how the software operates with the D90 in hand.

3.0 MAINTENANCE

3.1 HOUSING ASSEMBLY

The housing of the camera is fabricated from 6060T-6 Aluminum, providing very high strength combined with good corrosion resistance and light weight. It is, however, recommended that the unit be washed down with fresh water after each use. When the anode has deteriorated significantly, it should be replaced.

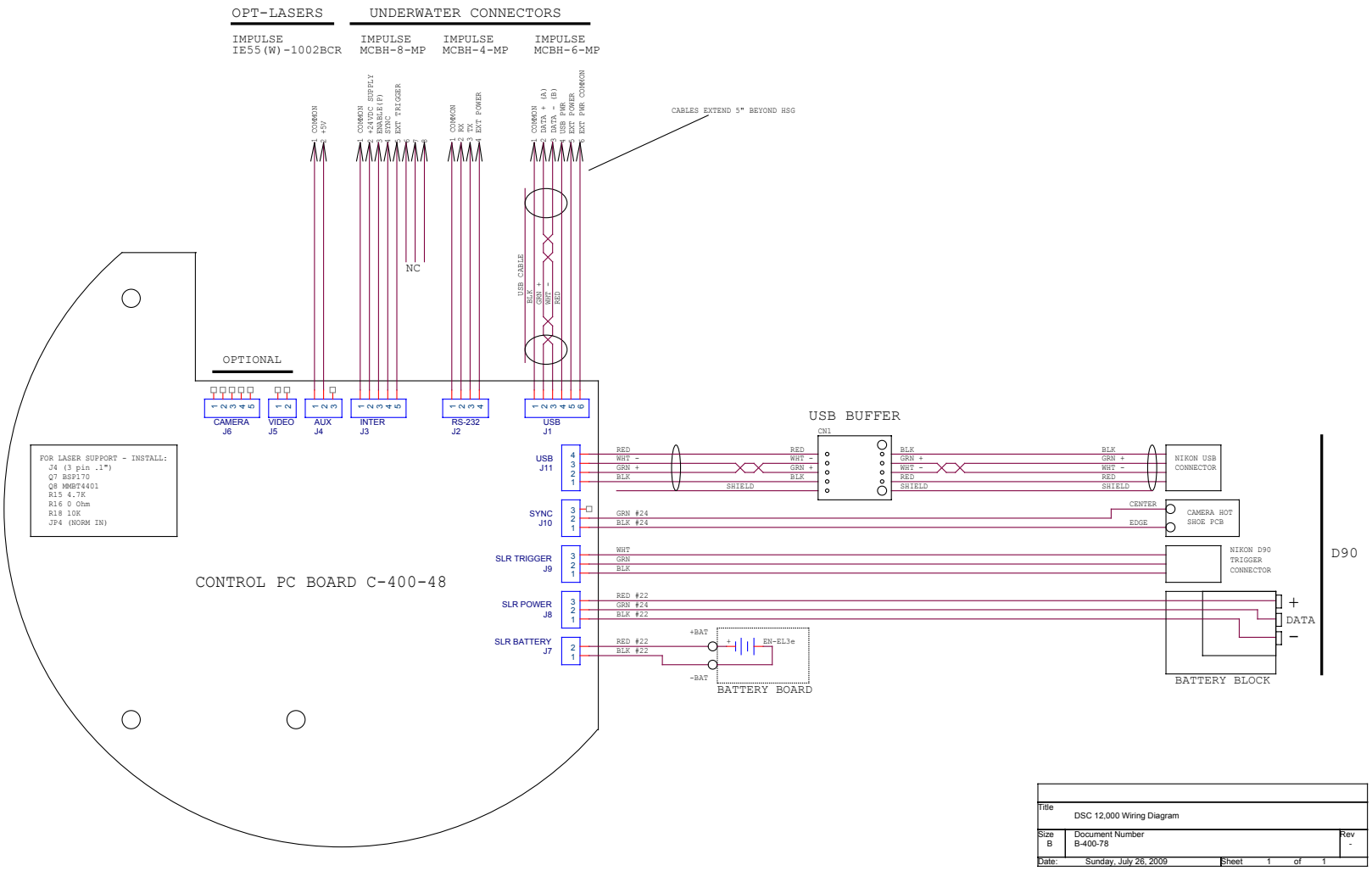
O-Rings used in this camera are:

2-236	O-ring, flat port
2-259	O-ring, end cap, radial
2-262	O-ring, end cap, face

3.2 USE OF LIQUEFIED GAS

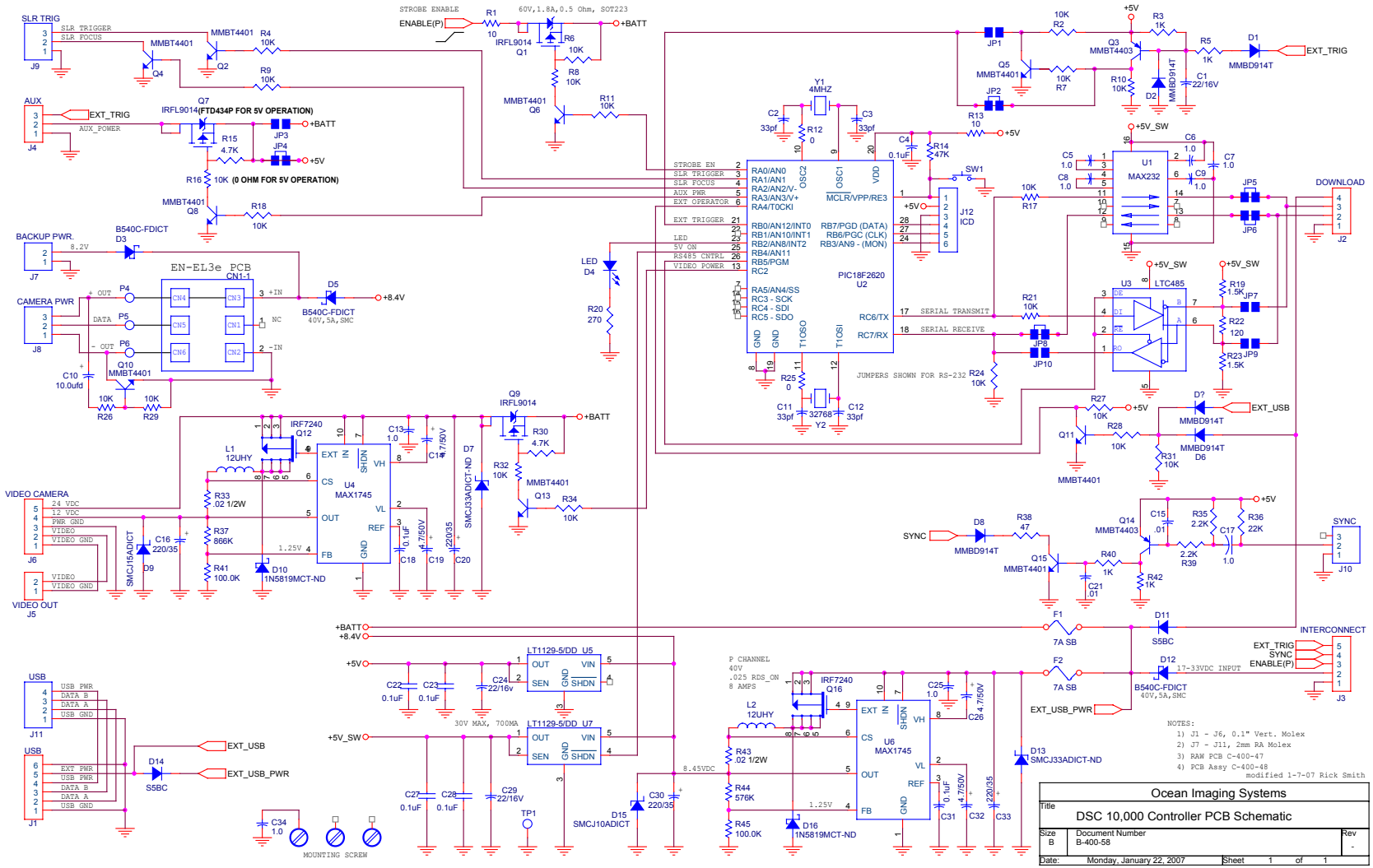
Each time the Model 12,000 camera is closed, the air in the housing should be displaced with an inert liquefied gas. This would reduce the possibility of corrosion and deterioration by elimination of oxygen. It also reduces the possibility of condensation of moisture in the flash when it is in the cold water of the deep ocean by elimination of water vapor. One of the most convenient ways of doing this is to put a small amount of liquefied gas into the housing before it is closed. This is best done with an inert gas that is heavier than air, installed with the housing open in a vertical position. Immediately after all the liquefied gas has evaporated, the unit should be closed. The gas should also be applied before the flash is in storage. Suggested products and suppliers are listed in Appendix A.

4.0 DRAWINGS



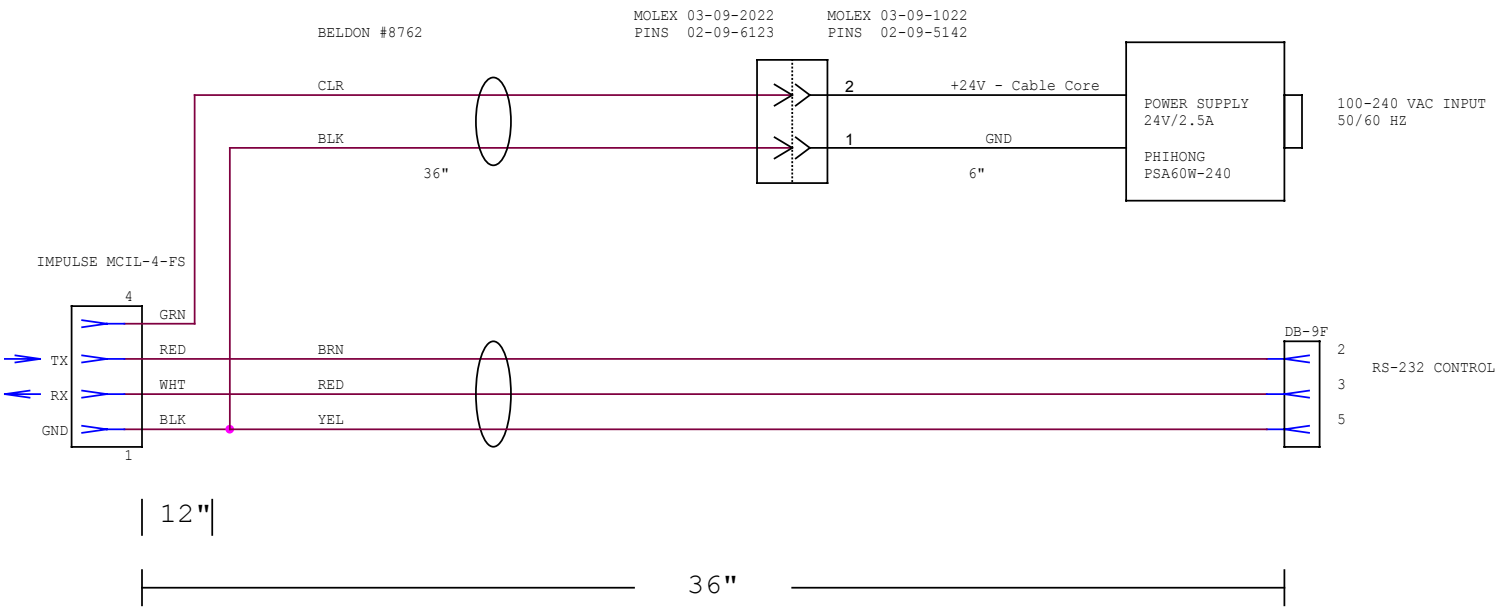
Model 12,000 Camera – Wiring Diagram – B-400-78

Figure 4-1



Model DSC 12,000 Camera – Control Board Schematic

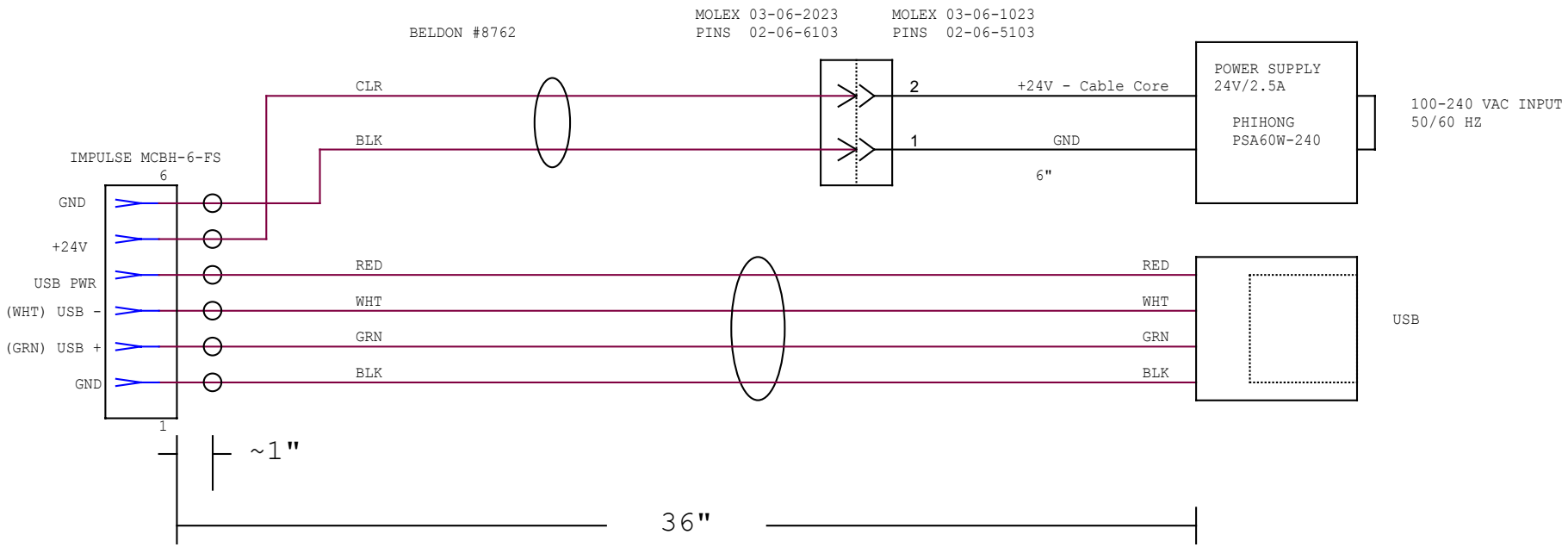
Figure 4-2



Title: DSC 10,000 RS-232 Control Cable		
Size: A	Document Number: A-400-72	Rev: -
Date: Sunday, March 25, 2007	Sheet 1 of 1	

Model 12,000 Camera – RS-232 Control Cable

Figure 4-3



Model 12,000 Camera – USB Cable - A-400-73

Figure 4-4

APPENDIX A

Liquefied Gas Products

The following are some of the liquefied gases available to displace air in the camera housing during use and storage. They are listed in order of their increasing environmental effect with regard to the problem of ozone depletion. We welcome suggestions for other appropriate gases that are readily available and environmentally safe. The desired properties are inert, dry, heavier than air, non-toxic, non-flammable and easily available.

SAFE:

BOTTLED NITROGEN - Available from welder's suppliers in 80cu. ft. and larger bottles

HCFC-22 BASED PRODUCTS (DICHLORODIFLUOROMETHANE):

GENETRON 22
Allied Signal
Special Chemicals Division
Morristown, New Jersey
201-455-2000

DUST OFF
Falcon Safety Products
Branchburg, New Jersey
908-707-4900

AERO-DUSTER
Miller-Stephenson Chemical Company
Danbury, Connecticut
1-800-992-2424

HCFC-12 BASED PRODUCTS (CHLORODIFLUOROMETHANE):

GENETRON 12
Allied Signal
Special Chemicals Division
Morristown, New Jersey
201-455-2000