I2MAP Camera System Design and Programming Notes

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Rev. A – 27AUG14 mrc
Rev. B – 24OCT14 mrc Added extra I/O
Rev. C – 13MAR15 mrc Modified I/O list, consolidated light switch fault flags.

1. Introduction.

This document describes the electrical design and is a programming reference for the i2MAP controller and electrical switching printed circuit board (LOCA). The function of the board is to provide local control of the camera and light system while interfacing with the Dorado AUV using a 10/100 Base-T Ethernet connection. A commercial module based on a PIC processor provides the communications and processor input/output functions for the board. The LOCA board is installed in the camera housing and provides the following functions:

a. Electrical switching and dimming control for four DeepSea Power & Light LED lights.
b. Electrical power control for the camera system, which includes the camera, the video recorder and the camera lens iris drive circuit.
c. Electrical power control for the SBE 25 CTD and the associated sensors.
d. Serial communications (EIA 232) to the SBE 25.
e. Serial communications (EIA 485) to the iris motor controller.
f. Logic power control for the AJA KiProQuad video recorder.
g. Local environmental monitoring for water alarms, internal housing temperature and humidity.
h. Camera video signal mean and peak signal levels (for iris control algorithim).
i. Power conversion from the AUV 18-36 Volt bus to local 12 and 5 VDC.

2. Detailed Circuit Description.

a. Embedded processor: Communications and input output functions (I/O) are provided by a commercial processor module from the Modtronix Corporation, PN SBC65EC (MODULE). This module has the advantage of having a TCP/IP stack and embedded firmware that allows configuration and control through a simple HTML interface. The functions of the host micro-processor, the PIC18F6627 CPU are all accessible through this interface, including 32 channels of analog and digital I/O.

b. **Electrical power switching:** The electrical switches for each of the individual lights, the camera system and the CTD loads are on Port B, pins 0-5. These ports should be configured as outputs. The ON state for the switch is when the pin signal is HIGH (note:

the proto-board is the opposite). Each of the output signals is also connected to a separate input port, Port T, pins 0-5. These Port T pins should be configured as inputs. The electrical switch modules include temperature and over-current fault detection. If a fault is detected by the power switch, the corresponding control line will be pulled low, over-riding the PIC processor port output switch drive, and the state can be sensed on the Port T, 0-5 inputs. For example in the normal state, to turn on switch 0, the Port B0 output would be driven high. The corresponding input, Port T0 would also transition to the high state. In a fault state, input Port T0 will subsequently be pulled low by the power switch, resulting in an opposite state from the commanded Port B0 state. To restore the switch, the cause of the fault must be removed, and the power switch cycled through the off state.

c. **AJA KiProQuad video recorder power control (RECORDER):** The electrical power for the RECORDER is switched using the circuit described in section B above. The RECORDER also requires a logic signal to mimic the action of the user pressed "power" button on the front panel. A 3.3V logic level circuit using MODULE Port B6 has been hacked into the recorder to provide this function. Control of the RECORDER logic power switch on/off function with Port B6 has the following properties:
    i. Turn on with momentary pulse (1 sec.?).
    ii. Turn off with pulse > 2 seconds.
    iii. All override off with pulse > 6 seconds.

d. **Dimming control:** The dimming function uses pulse width modulation and an integrating circuit to provide a 0-5V output from the RC1, RC2, RG0 and RG3 output pins. These pins must be configured as outputs.
e. **SBE 25 CTD serial communications**: The communications with the SBE 25 use the processor MODULE internal USART, channel 1. The on-MODULE 232 transceiver is also used.
f. **Camera lens iris position control:** The i2MAP system camera does not have any method of providing an internal auto-iris function. To allow for camera system operation under variable lighting conditions a lens iris drive system is implemented using a small stepper motor to drive the lens and an EZ Stepper model EZ17 motor controller. The communications between the MODULE and the EZ17 controller are EIA 485 serial protocol and the LOCA board provides a 485 transceiver and the required line turn-around circuit to arbitrate between the full duplex MODULE TTL communications and the half-duplex EIA 485 standard.

    Under conditions of little ambient lighting, the iris is driven to and held in the *f*5.6 position based on a lookup table of motor-steps to desired position from the mechanical stop at the minimum iris position (details still TBD). Under conditions of high ambient light levels (near the surface in daylight), two signals are provided to assist in setting the appropriate iris position. The first is the peak video signal level on the A/D converter input, Port A0. The peak video signal level should be about 0.9V. The second signal is the

mean video signal level on the A/D converter input, Port A1. Depending on the type of scene, the mean level should be less than 0.5V. Using these two inputs, an adjustable algorithm weights each appropriately and compares the results to a set variable. Using the difference between the actual values and the set point, a look-up table is used to adjust the iris position before each recording when in environments of high ambient lighting. Note: this is a bunch of wild BS, but we have to come up with something similar.

g. **Temperature sensing and over-temperature shutdown:** The housing ambient temperature is sensed with an analog module connected to the A/D converter input Port A3. The sensor outputs 500mV + (10mV per degree Celsius), for example, 20° C = 0.7V. There is an over-temperature protection circuit in the electrical hardware that shuts down the 15 Volt power supply if the housing internal temperature reaches 40 degrees C. The circuit has 5 degrees of hysteresis and will not re-enable 15 Volt power until the temperature drops to 35 degrees C. If the system goes into over-temperature shutdown in hardware then all communications with the system are lost and there is no other indication of this event. For this reason the software application should perform an orderly camera and recorder shutdown when the housing temperature reaches 35 degrees C.

h. **Humidity sensing**: To sense humidity, an analog sensor is connected to A/D converter input Port A2. The output of 0.5 to 2.5V corresponds to 0-100% humidity.

i. **Water alarms**: A water alarm contact is installed in the fore and aft ends of the camera pressure housing. The fore sensor is connected to A/D converter input Port A5 and the aft sensor connected to Port A4. A voltage of greater than 0.5V on these inputs signifies a water alarm.

3. Programming Notes.

a. Modtronix Engineering model SBC65EC connector pin description.

CON 1 CONNECTOR					CON 2 CONNECTOR				
NAME	PIN	SIGNAL	FUNCTION	Active State	NAME	PIN	SIGNAL	FUNCTION	Active State
T0	2	PIC pin RF0	Power switch SW0 fault input	High	T4	2	PIC pin RF4	Not used	High
T1	1	PIC pin RF1	Power switch SW1 fault input	High	T5	1	PIC pin RF5	Not used	High
T2	4	PIC pin RF2	Power switch SW2 - SW5 fault input	High	T6	4	PIC pin RF6	Over temperature fault input	Low
T3	3	PIC pin RF3	Not used	High	T7	3	PIC pin RF7	Output for power control of the AJA KiProQuad recorder	Driven Low
SIG0	6	USART 1 receive signal - RS232	SBE-25 comms receive (232)		GND	5	Ground	Power return	
SIG1	5	USART 1 transmit signal - RS232	SBE-25 comms xmit (232)		+5V	7	Regulated 0.5A 5V supply	5 V Power input if regulated supply available	
B0	13	PIC pin RB0	Output Switch 0	High	VIN	8	Unregulated input voltage	7-35 V Power input	
B1	14	PIC pin RB1	Output Switch 1	High	CLR#	6	PIC pin /MCLR	Not used	
B2	11	PIC pin RB2	Output Switch 2	Driven Low	A0	10	PIC pin RA0	Analog input peak video level 0-5V	
B3	12	PIC pin RB3	Output Switch 3	Driven Low	A1	9	PIC pin RA1	Analog input mean video level 0-5V	
B4	9	PIC pin RB4	Output Switch 4	Driven Low	A2	12	PIC pin RA2	Analog input for humidity sensor 0-5V	
B5	10	PIC pin RB5	Output Switch 5	Driven Low	A3	11	PIC pin RA3	Analog input for temp sensor 0-5V	
B6	7	PIC pin RB6 – also used for ICP (1)	Not used		A4	14	PIC pin RA4	Analog input FWD water alarm	voltage > 0.5 V = water
B7	8	PIC pin RB7 – also used for ICP (1)	Not used		A5	13	PIC pin RA5	Analog input AFT water alarm	voltage > 0.5 V = water
C4	17	PIC pin RC4 – port pin assigned for I2C (2)	Not used		C0	16	PIC pin RC0	Not used	
C5	18	PIC pin RC5	Not used		C1	15	PIC pin RC1	PWM output for all light dimming	Not Driven or Driven High = 100% = full pwr
C6	15	PIC pin RC6	Not used, Xmit output for USART 1 (TTL)		C2	18	PIC pin RC2	Not used	
C7	16	PIC pin RC7	Not used, Rec input for USART 1 (TTL)		C3	17	PIC pin RC3 – port pin assigned for I2C (2)	Not used	
D6	19	RG2 – USART2 Receive	Camera Iris controller receive (TTL)		D0	20	RG0	Not used	
D7	20	RG3	Not used		D1	19	RG1 – USART2 Transmit	Camera Iris controller xmit (TTL)	

b.