



**Technical Circuit Design
Guidelines for
PLC on a Chip
PLC on a Chip Module**

CIRCUIT DESIGN GUIDELINES

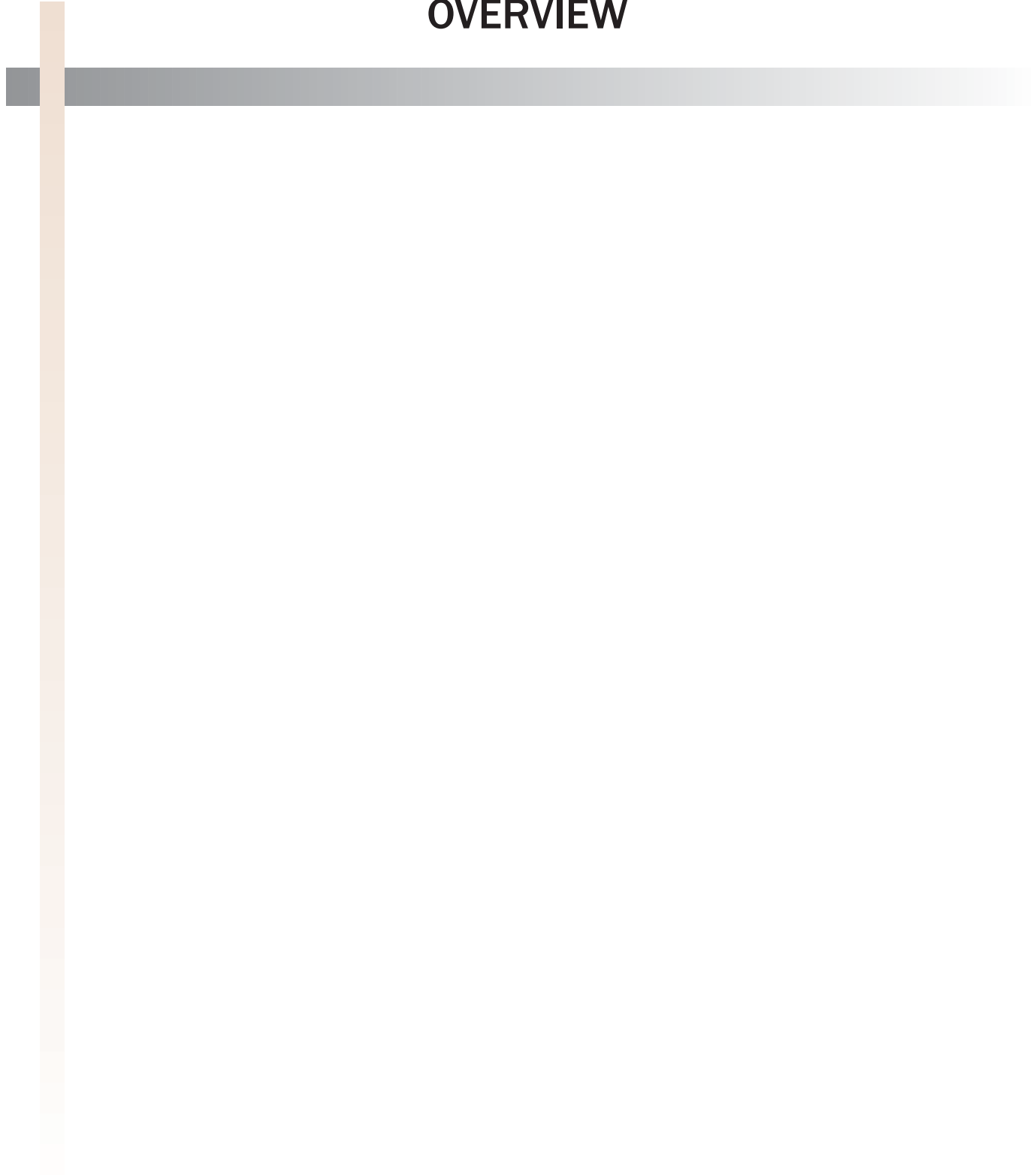


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SECTION 1

OVERVIEW



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Revision History

<u>Revision</u>	<u>Release Date</u>	<u>Description of Changes</u>
Rev. A		Initial Release of Document.
Rev. B	3/28/2005	Corrected Document Typing Errors
Rev. C	3/20/2005	Added LCD Display & Keypad Circuits

IMPORTANT NOTICE

Divelbiss reserves the right to discontinue or make changes to its products without notice. As the circuits are provided for reference only, customers assume the responsibility for the appropriate application of Divelbiss components. It is the customer's responsibility to ensure that adequate design and operating safeguards are addressed to eliminate any hazards inherent to their application.

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Definitions

HDIO Divelbiss high density input output bus
SSI Synchronous Serial Interface

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About this Document

The following circuit designs are examples to aid in the implementation and development of products based on PLC on a Chip. All provided circuit designs, part numbers and other information is provided without any guarantee or warranty as to functionality, use or implementation and Divelbiss assumes no liability in the use of the provided circuit design information.

These copyrighted circuits provide allowed use when used with PLC on a Chip designs and products.

The user should consult component manufacturer's datasheets and design recommendations as appropriate for end application and operating environment.

Notes: The +5VDC and +12VDC power supplies shown in the following circuits should be regulated and only used internally to the finished product for isolation and to promote noise immunity.

For improved operational reliability and noise immunity, all unused input pins should be connected to Ground (GND).

Example board layouts are provided for circuits where the layout is critical. Circuits without layouts provided must be layed out following best PCB design practices and should follow these basic guidelines.

- Keep internal logic and other traces separated from each other.
- Maintain minimum trace sizing for the current capacity / requirement for the circuit.
- Electrically isolate field wiring where appropriate.

SECTION 2

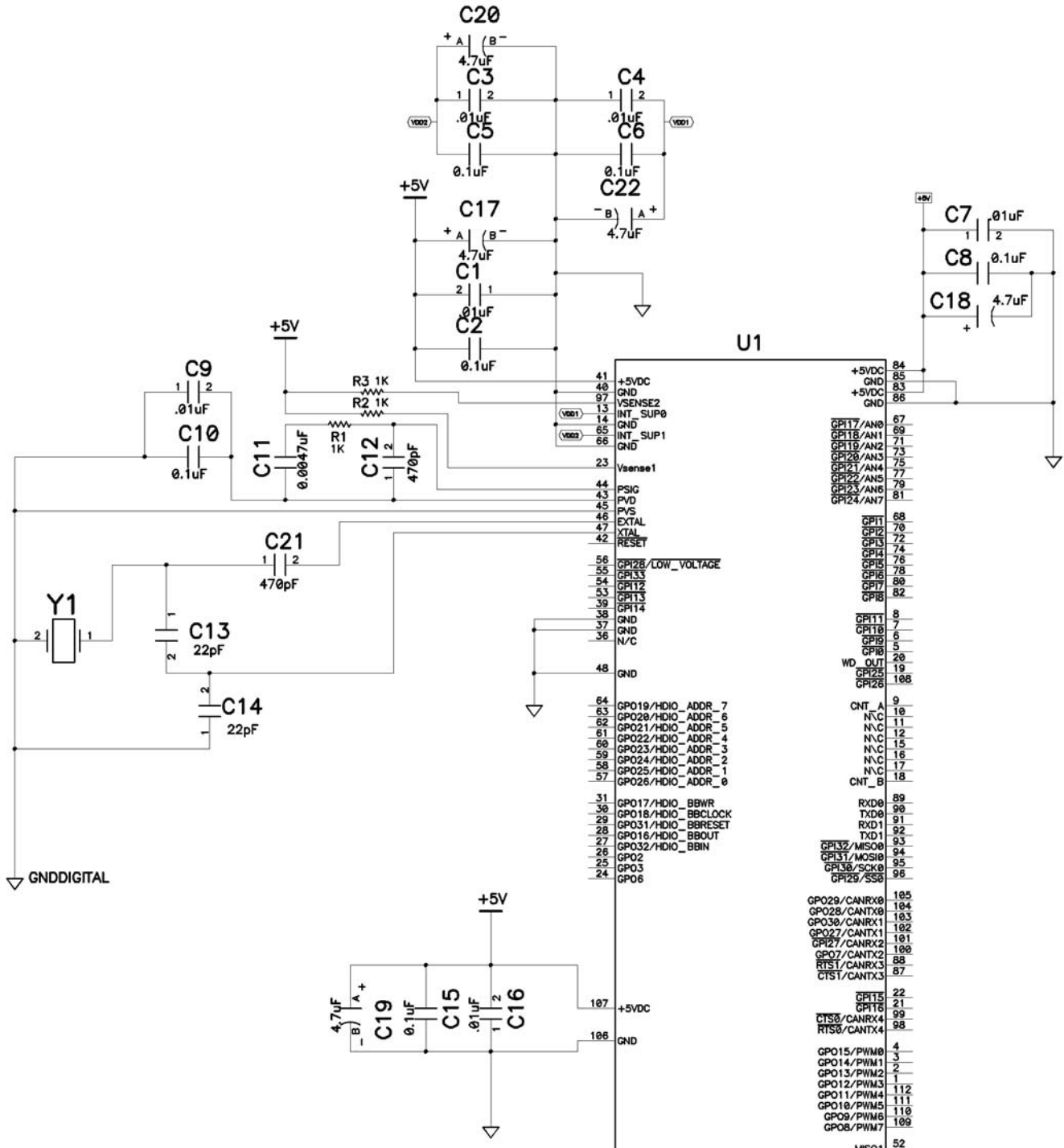
PLC ON A CHIP BASIC CIRCUITS



Oscillator & Power Terminations

The Oscillator and Power circuit provides the basic power terminations and oscillator configuration for the PLC on a Chip to function.

EXAMPLE OSCILLATOR & POWER TERMINATIONS SCHEMATIC



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EXAMPLE OSCILLATOR & POWER TERMINATIONS PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	PLC on a Chip IC	Divelbiss Corporation	PLCHIP-M2XXX-X-X
Y1	12.000 MHZ Crystal or equivalent, 20 PF	FOX	FOXSD/120-20
R1, R2, R3	Resistor, 1 K Ohm, 1/8 Watt, 5%	Various	Various
C1, C3, C4, C7, C9, C16	Capacitor, .01uF, +/-20%, Ceramic, 50V	Various	Various
C2, C5, C6, C8, C10, C15	Capacitor, .1uF, +/-20%, Ceramic, 50V	Various	Various
C13, C14	Capacitor, 22pF, +/-10%, Ceramic, 50V	Various	Various
C11	Capacitor, .0047uF, +/-10%, Ceramic, 50V	Various	Various
C12, C21	Capacitor, 470pF, +/-10%, Ceramic, 50V	Various	Various
C17-C20, C22	Capacitor, 4.7uF, +/-110%, Tanatlum, 50V	Various	Various

BY-PASS CAPACITORS

Bypass capacitors are required on various pins on the PLC on a Chip to ensure proper operation. These capacitors are detailed below.

INT_SUP0 (pin13), GND(pin14)

A ceramic capacitor (0.1uF typical) of type X7R (or higher quality) is required. This capacitor should be located as closely to the pin as possible. It is critical that no other components, voltages, or nets be connected to this INT_SUP0 pin.

INT_SUP1 (pin65), GND(pin66)

A ceramic capacitor (0.1uF typical) of type X7R (or higher quality) is required. This capacitor should be located as closely to the pin as possible. It is critical that no other components, voltages, or nets be connected to this INT_SUP1 pin.

+5VDC (pins 41, 83, 84, 107), GND (pins 40, 85, 86, 106)

A ceramic capacitor (0.1uF typical) of type X7R (or higher quality) is required. This capacitor should be located as closely to the pin as possible

REQUIRED PULL-UP RESISTORS

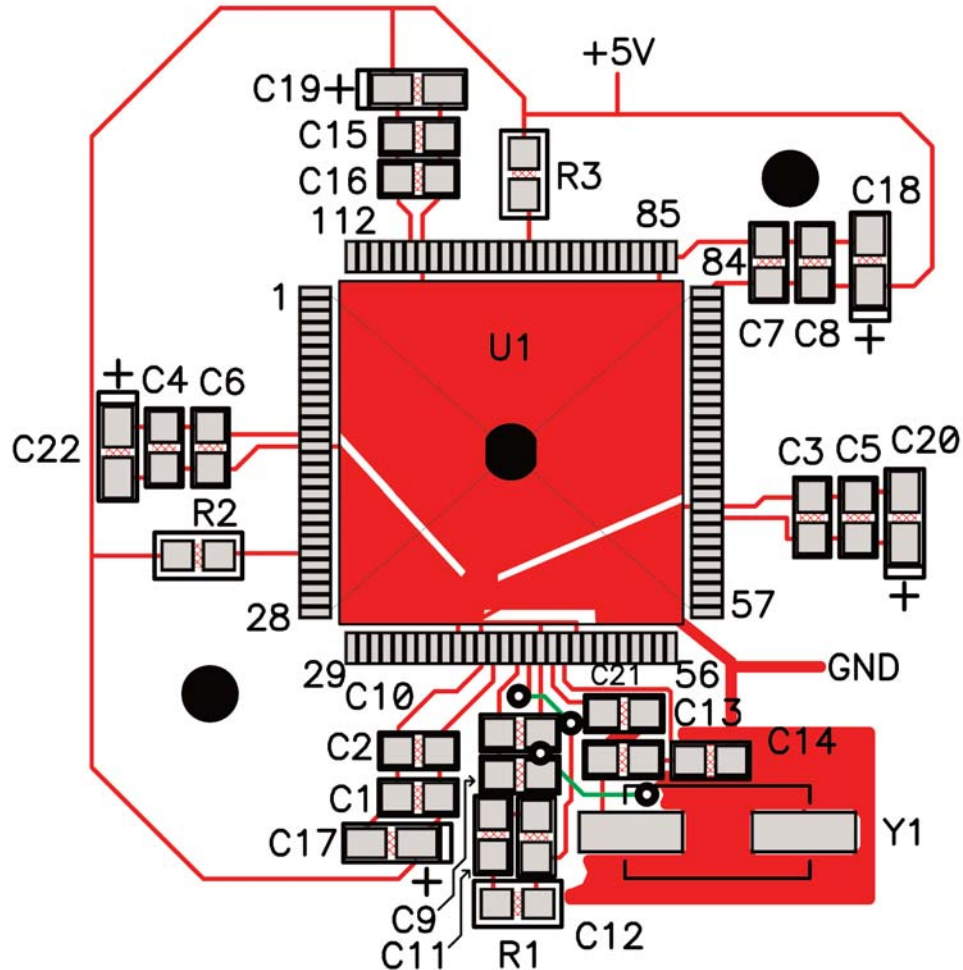
Pull-up resistors are required on the following pins.

VSENSE1 (pin 23)

VSENSE2 (pin 97)

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PCB LAYOUT EXAMPLE



PCB Layout Notes:

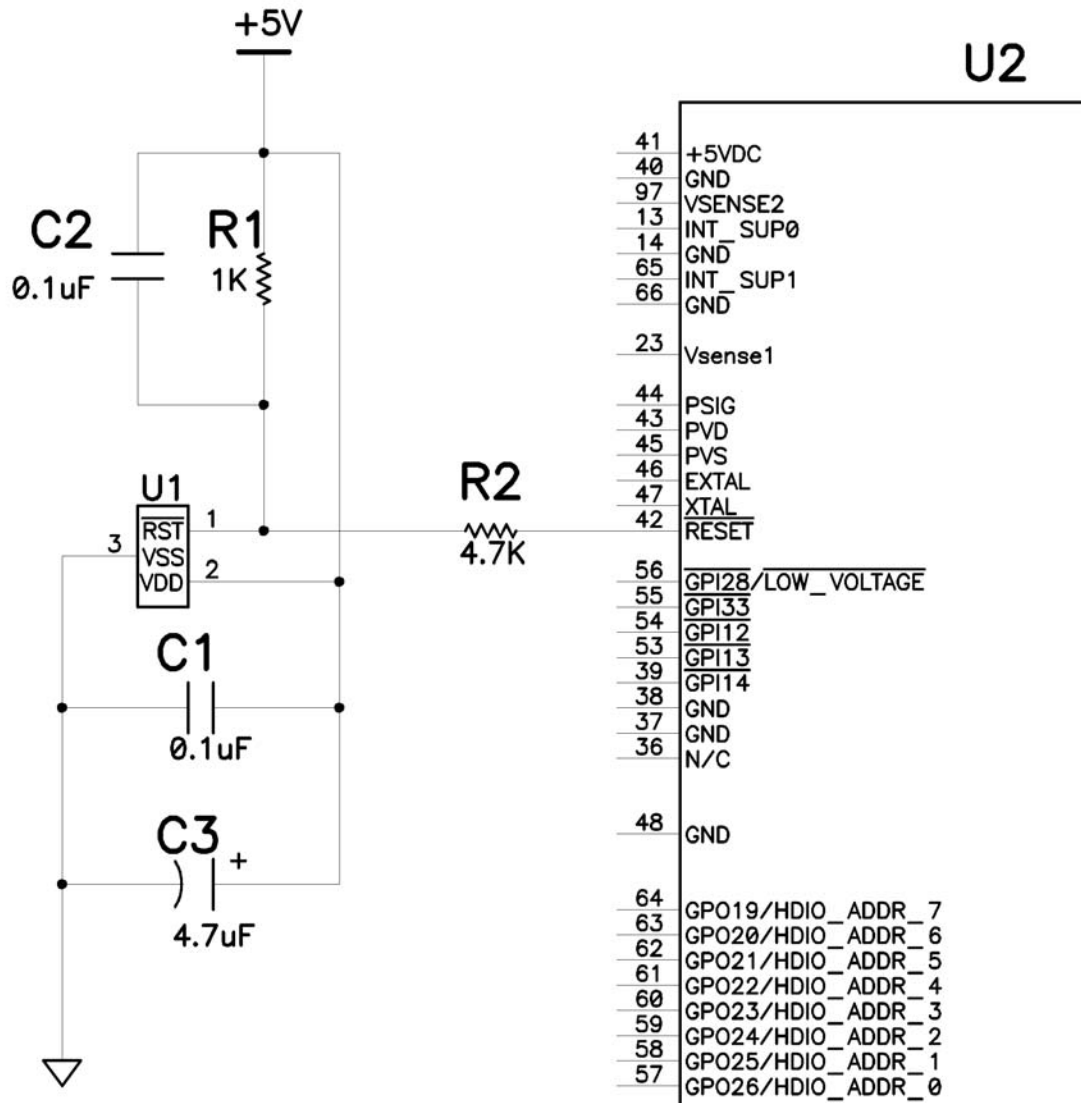
- Every supply pair must be decoupled by ceramic and tantalum capacitors connected as near as possible to the corresponding pins.
- Central point of the ground star should be Pin 40.
- Use low ohmic, low inductance connections between Pin 14, Pin 66 and Pin 40.
- PVS must be directly connected to Pin 40.
- Keep traces of PVS, EXTAL and XTAL as short as possible and occupied board area for C13, C14 and Y1 as small as possible.
- Do not place other signals or supplies underneath area occupied by C13, C14, Y1 and the connection area to PLC on a Chip.
- Central power input should be fed in at Pin 83 and Pin 86.

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Power on Reset

A power on reset device should be used to ensure proper startup of the PLC on a Chip. The power on reset device should have an open drain output as the reset line of the PLC on a Chip is bi-directional. It is also recommended that the power on reset device have a built-in delay to ensure adequate power supply stabilization.

POWER ON RESET SCHEMATIC



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POWER ON RESET PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	Power on Reset IC with open drain.	Microchip	MCP120-450-I/TT
U2	PLC on a Chip IC	Divelbiss Corporation	PLCHIP-M2XXX-X-X
C1, C2	Capacitor, .1uF, +/-20%, Ceramic, 50V	Various	Various
C3	Capacitor, 4.7uF, +/-20%, Tantalum, 20V	Various	Various
R1	Resistor, 1 K Ohm, 1/8 Watt, 5%	Various	Various
R2	Resistor, 4.7 K Ohm, 1/8 Watt, 5%	Various	Various

SECTION 3

INTERFACE CIRCUITS

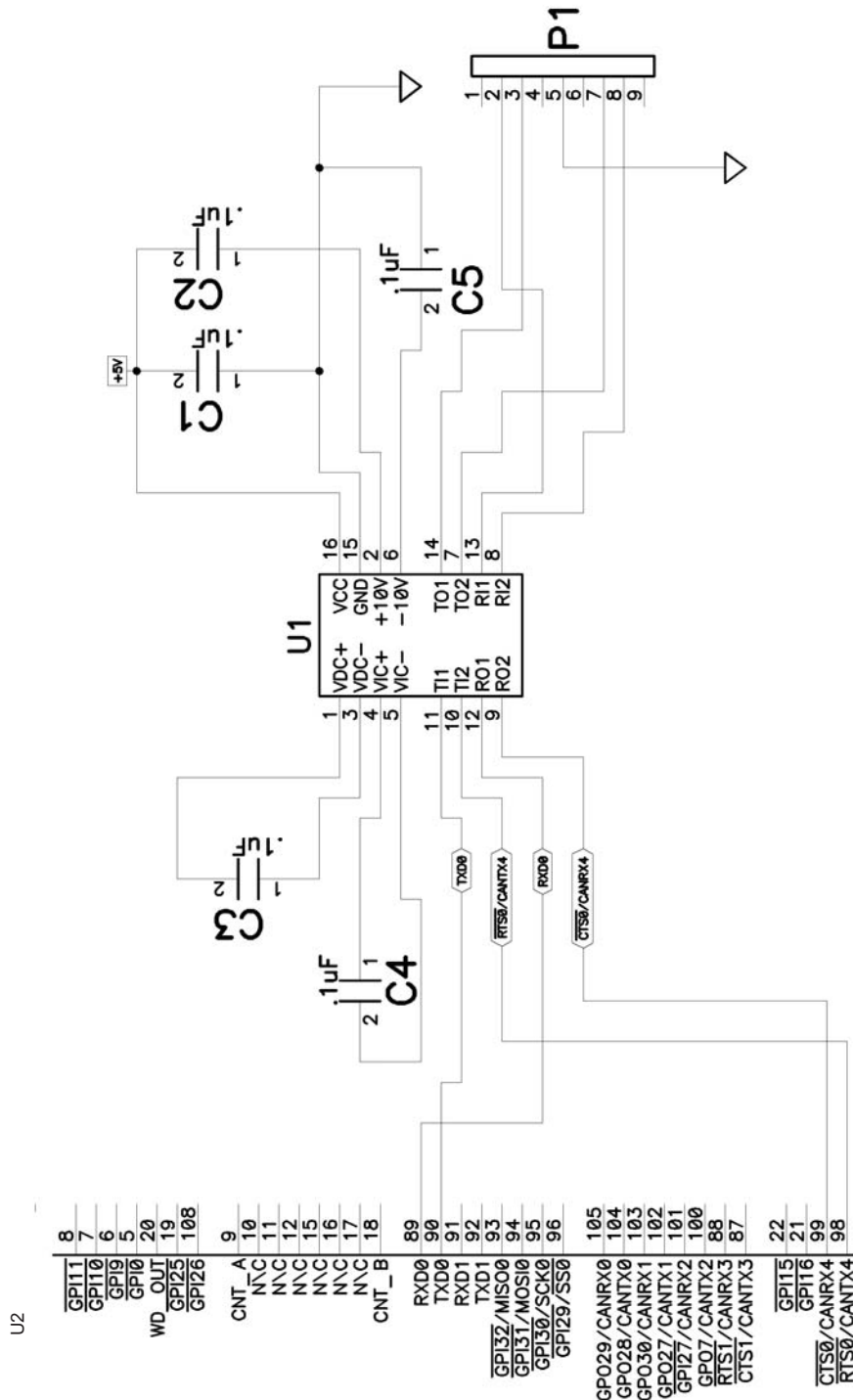


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RS232 Serial Port

The PLC on a Chip requires a serial interface to connect with a PC running EZLADDER for programming. Typically this is done via RS232.

RS232 INTERFACE SCHEMATIC



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RS232 INTERFACE PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	RS232 Transceiver IC or equivalent	Maxim Semiconductor	MAX232A
U2	PLC on a Chip IC	Divelbiss Corporation	PLCHIP-M2XXX-X-X
P1	Connector, DB9, PCB Mount	Various	Various
C1, C2, C3 C4, C5	Capacitor, 0.1 uF, +/- 10%, Ceramic, 25V	Various	Various

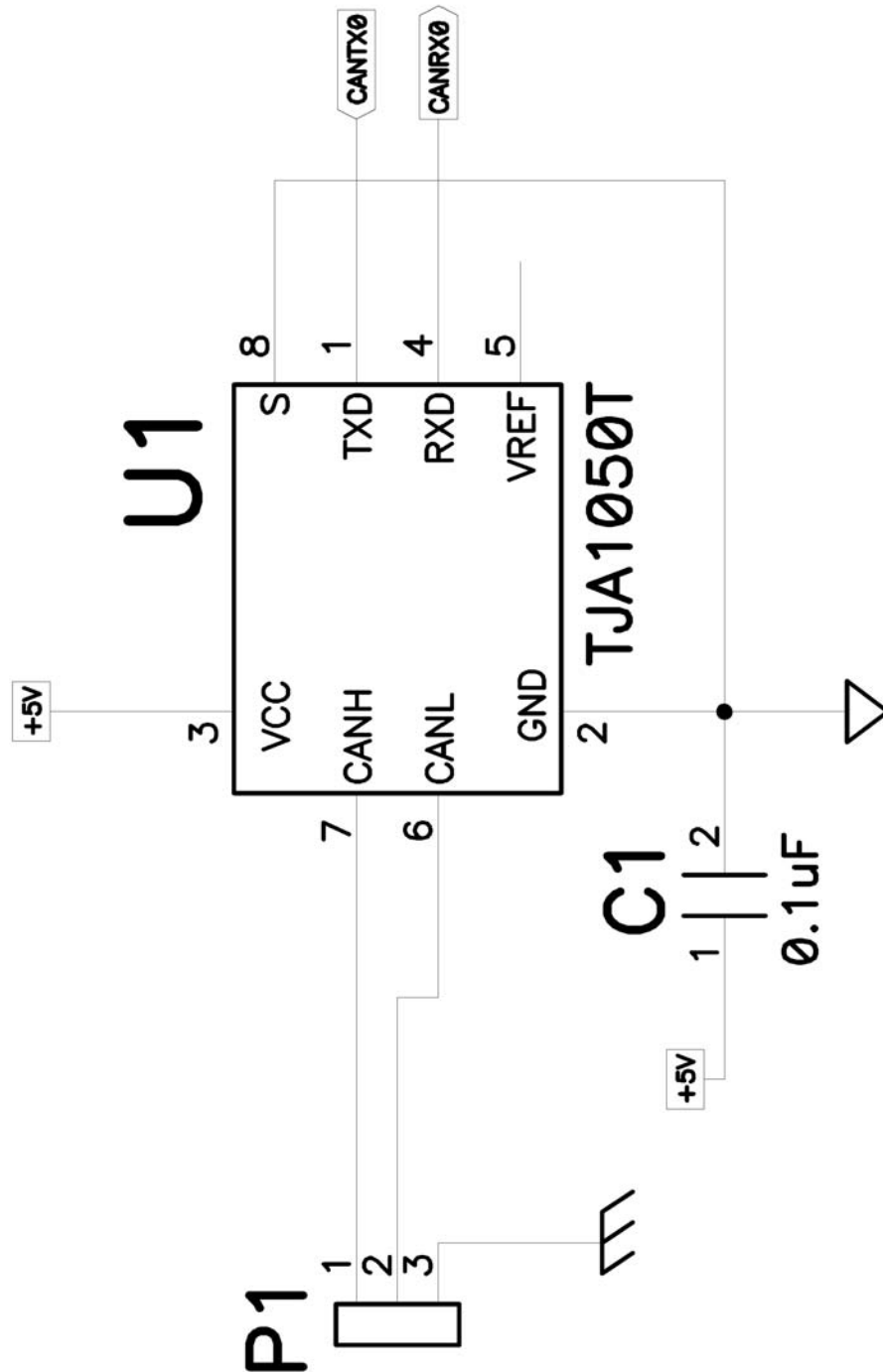
Refer to the RS232 Transceiver ICs Manufacturer's Data Sheet for Electrical Specifications

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CAN Network

Typical CANbus interface circuit.

CAN BUS INTERFACE SCHEMATIC



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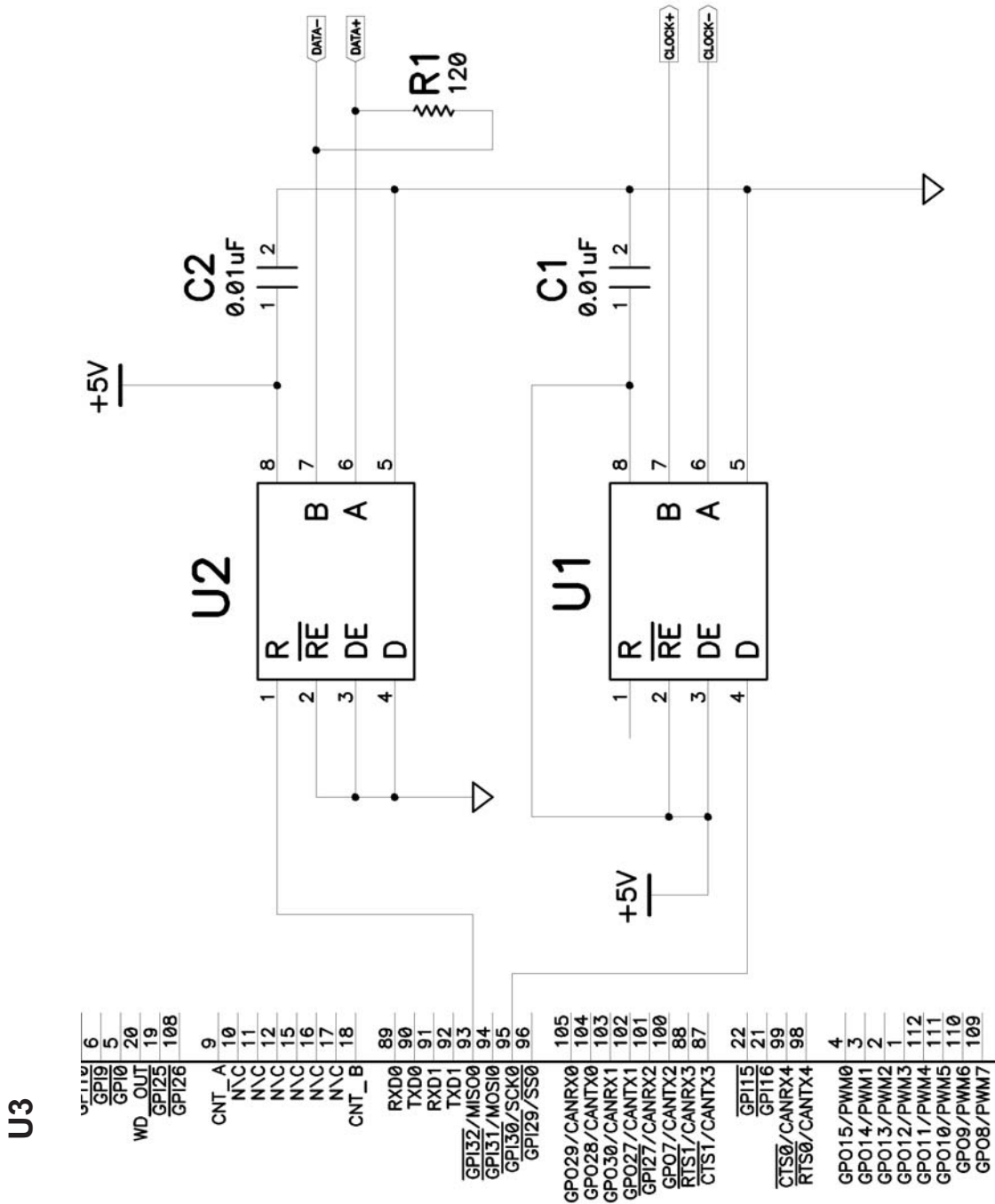
CAN BUS INTERFACE PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	Can Transceiver IC	Philips Semiconductor	TJA1050T
P1	Connector, 3 Position	Various	Various
C1	Capacitor, .1uF, -0/+100%, Ceramic, 50V	Various	Various

SSI Interface

This is a typical SSI interface circuit. Refer to the encoder's datasheet for interface information.

SSI INTERFACE SCHEMATIC



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SSI INTERFACE PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1, U2	Differential Bus Transceiver	Texas Instruments	SN75LBC184
U3	PLC on a Chip IC	Divelbiss Corporation	PLCHIP-M2XXX-X-X
R1	Resistor, 120 Ohm, 1/8 Watt, 5%	Various	Various
C1, C2	Capacitor, .01uF, -0/+100%, Ceramic, 50V	Various	Various

The differential bus transceivers may require substitution depending upon the data rate required.

Keypad Interface

This keypad interface circuit provides a simple and effective method to add keypad functionality during product development of your PLC on a Chip Custom Product.

A keypad 'matrix' may be placed on any one of three specified PLC on a Chip ports (except COL 5 pin is factory set only). Please refer to the tables below for the keypad assignments versus the PLC on a Chip pin assignments. All pin assignments are for shown for the integrated circuit.

KEYPAD OPTION A - PWM PINS (Pins 1-4, 109-112)		
Keypad Assignment	Pin Description	Pin #
ROW 1	GPO15	4
ROW 2	GPO14	3
ROW 3	GPO13	2
ROW 4	GPO12	1
COL 1	GPO11	112
COL 2	GPO10	111
COL 3	GPO9	110
COL 4	GPO8	109

KEYPAD OPTION C - HDIO PINS (Pins 57-64)		
Keypad Assignment	Pin Description	Pin #
ROW 1	GPO26	57
ROW 2	GPO25	58
ROW 3	GPO24	59
ROW 4	GPO23	60
COL 1	GPO22	61
COL 2	GPO21	62
COL 3	GPO20	63
COL 4	GPO19	64

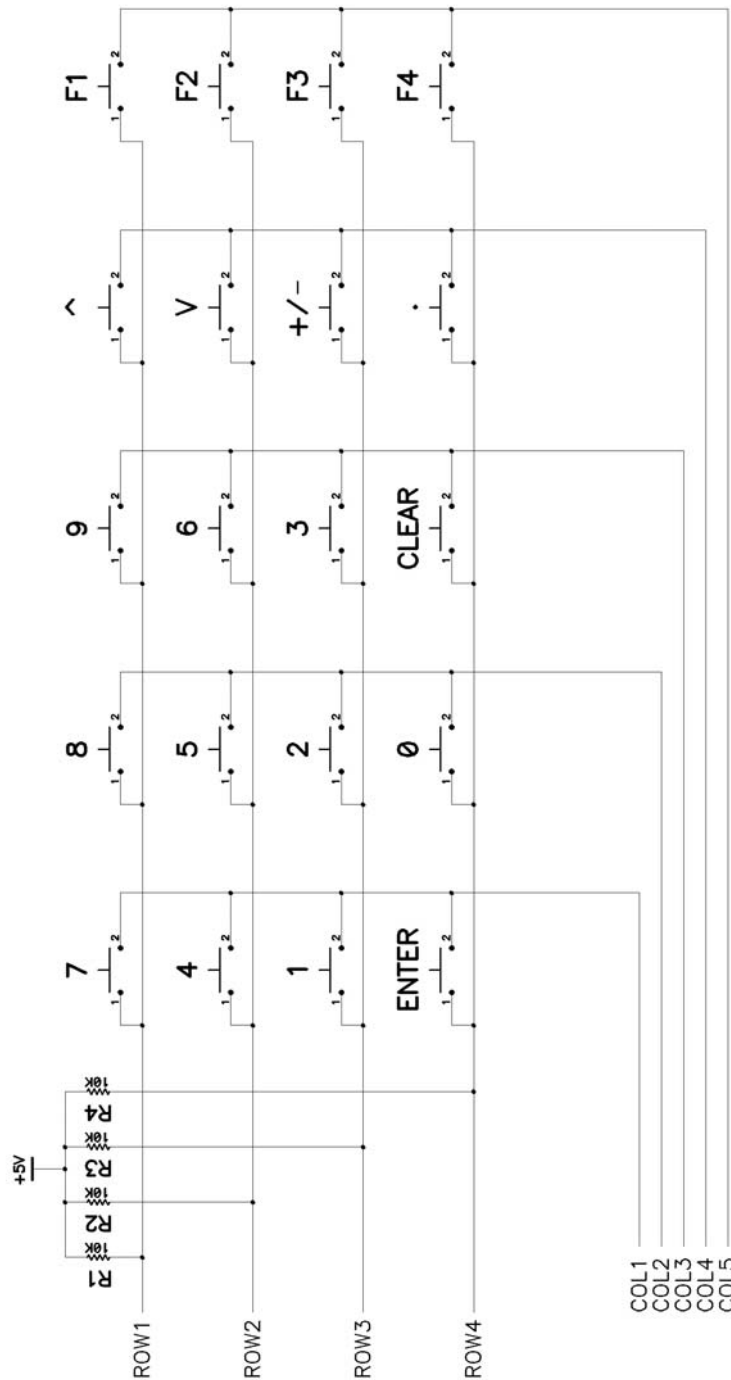
KEYPAD OPTION B - CAN PINS (Pins 87-88, 100-105)		
Keypad Assignment	Pin Description	Pin #
ROW 1	GPO29	105
ROW 2	GPO28	104
ROW 3	GPO30	103
ROW 4	GPO27	102
COL 1	GPI27	101
COL 2	GPO7	100
COL 3	RTS1	88
COL 4	CTS1	87

KEYPAD COL 5 - Required for all Keypad Options		
Keypad Assignment	Pin Description	Pin #
COL 5	GPI26	108

A keypad example schematic is shown on page 3-9.

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KEYPAD INTERFACE EXAMPLE SCHEMATIC



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LCD Display Interface

This LCD Display interface circuit provides a simple and effective method to add LCD Display functionality during development to your PLC on a Chip Custom Product. **The LCD display must a HD44780 Controller or equivalent for compatability.**

The LCD display can be connected to any one of three specified PLC on a Chip ports (except RS, RW and E pins are factory set only). Please refer to the tables below for the display assignments versus the PLC on a Chip pin assignments. All pin assignments are for shown for the integrated circuit.

LCD OPTION A - PWM PINS (Pins 1-4, 109-112)		
Keypad Assignment	Pin Description	Pin #
D0	GPO15	4
D1	GPO14	3
D2	GPO13	2
D3	GPO12	1
D4	GPO11	112
D5	GPO10	111
D6	GPO9	110
D7	GPO8	109

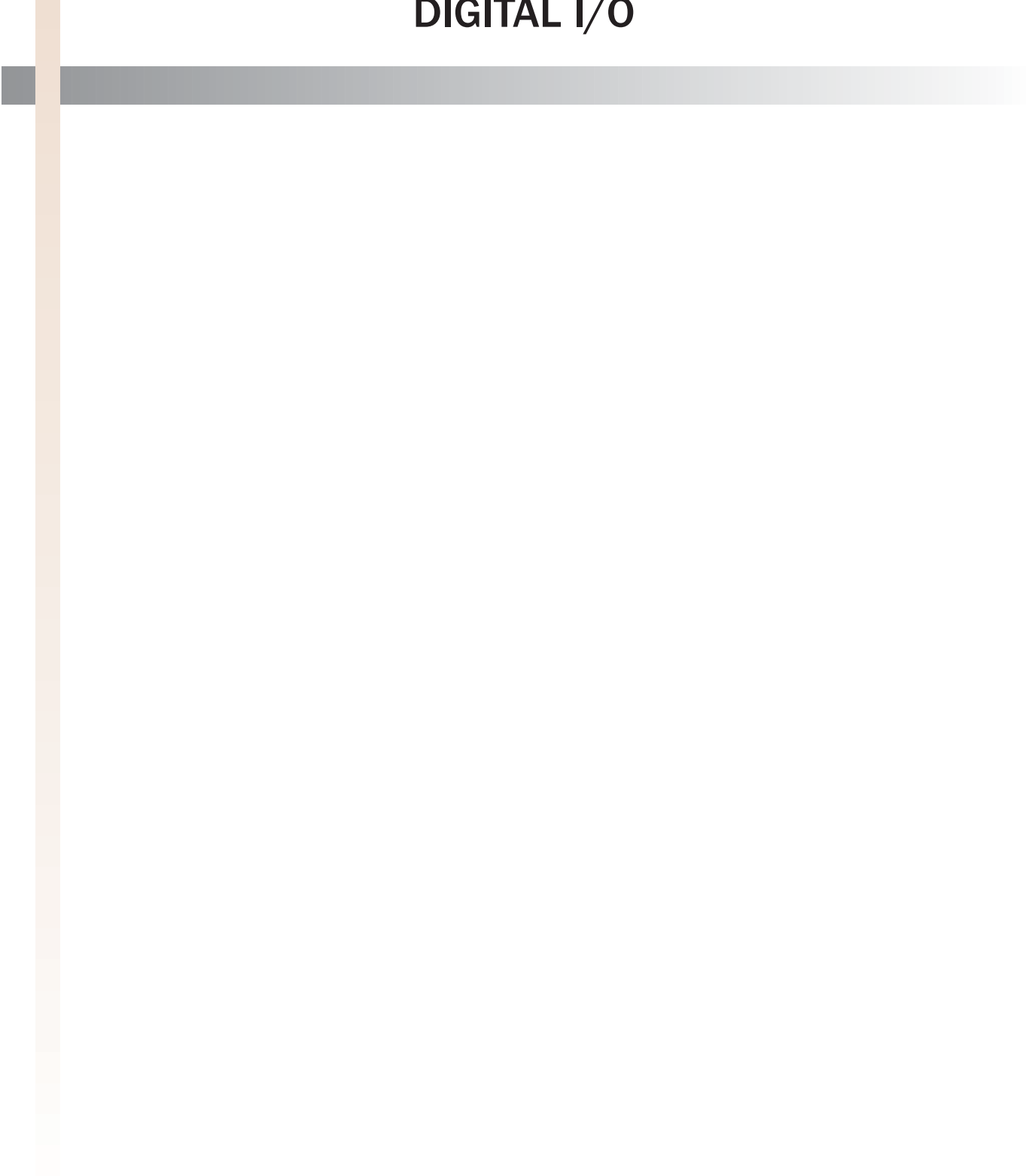
LCD OPTION C - HDIO PINS (Pins 57-64)		
Keypad Assignment	Pin Description	Pin #
D0	GPO26	57
D1	GPO25	58
D2	GPO24	59
D3	GPO23	60
D4	GPO22	61
D5	GPO21	62
D6	GPO20	63
D7	GPO19	64

LCD OPTION B - CAN PINS (Pins 87-88, 100-105)		
Keypad Assignment	Pin Description	Pin #
D0	GPO29	105
D1	GPO28	104
D2	GPO30	103
D3	GPO27	102
D4	GPI27	101
D5	GPO7	100
D6	RTS1	88
D7	CTS1	87

LCD - Required for all Keypad Options		
Keypad Assignment	Pin Description	Pin #
RS	GPI15	22
RW	GPI16	21
E	GPI25	19

SECTION 4

DIGITAL I/O

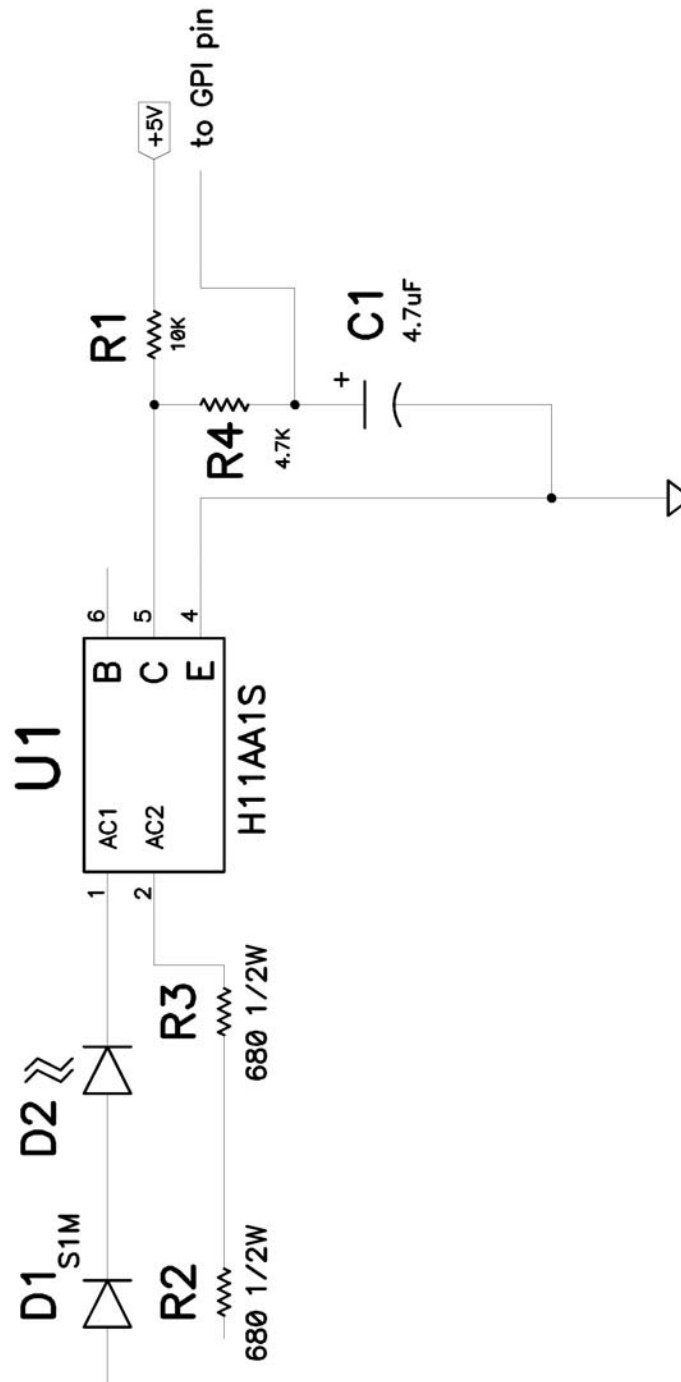


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8-32 VDC Input

Typical digital input, with an input range of 8-32VDC.

8-32 VDC INPUT SCHEMATIC



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8-32 VDC INPUT PARTS LIST

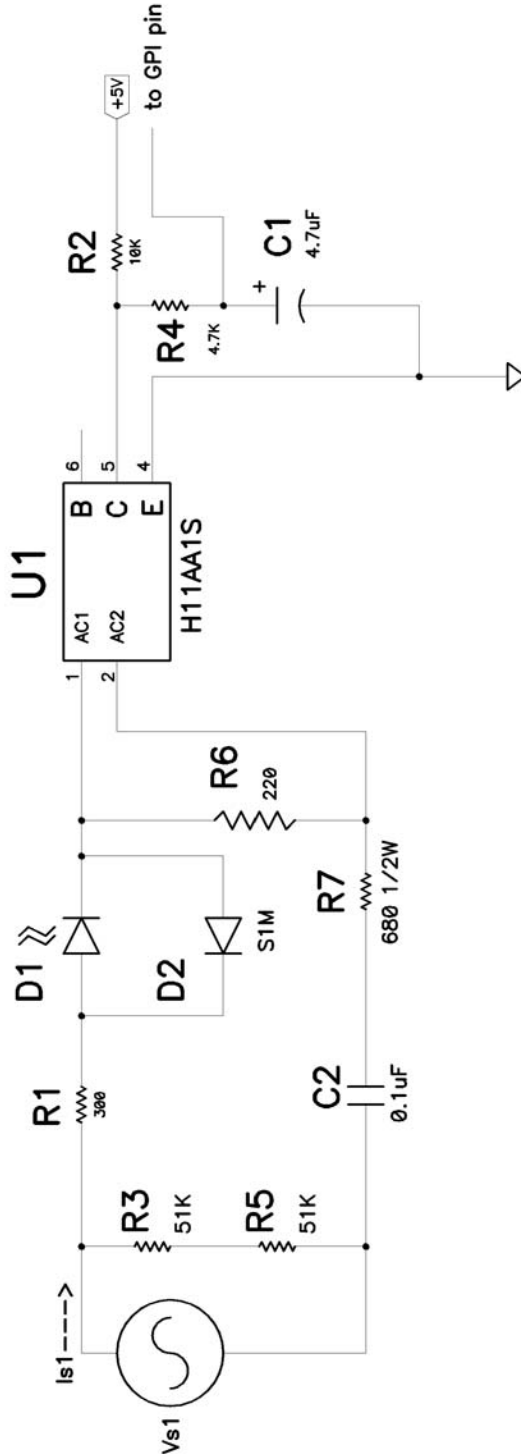
Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	Optoisolator IC, H11AA1S or equivalent	Fairchild	H11AA1S
D1	Diode, 1Amp, 1000V or equivalent	Various	S1M
D2	LED	Various	Various
R1	Resistor, 10 K Ohm, 1/8 Watt, 5%	Various	Various
R2, R3	Resistor, 680 Ohm, 1/2 Watt, Thick Film, 5%	Various	Various
R4	Resistor, 4.7 K Ohm, 1/8 Watt, 5%	Various	Various
C1	Capacitor, 4.7uF, +/-20%, Tantalum, 20V	Various	Various

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24-120 VAC Input

Typical digital input, with an input range of 24-120VAC (60Hz).

24-120 VAC INPUT SCHEMATIC



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24-120 VAC INPUT PARTS LIST

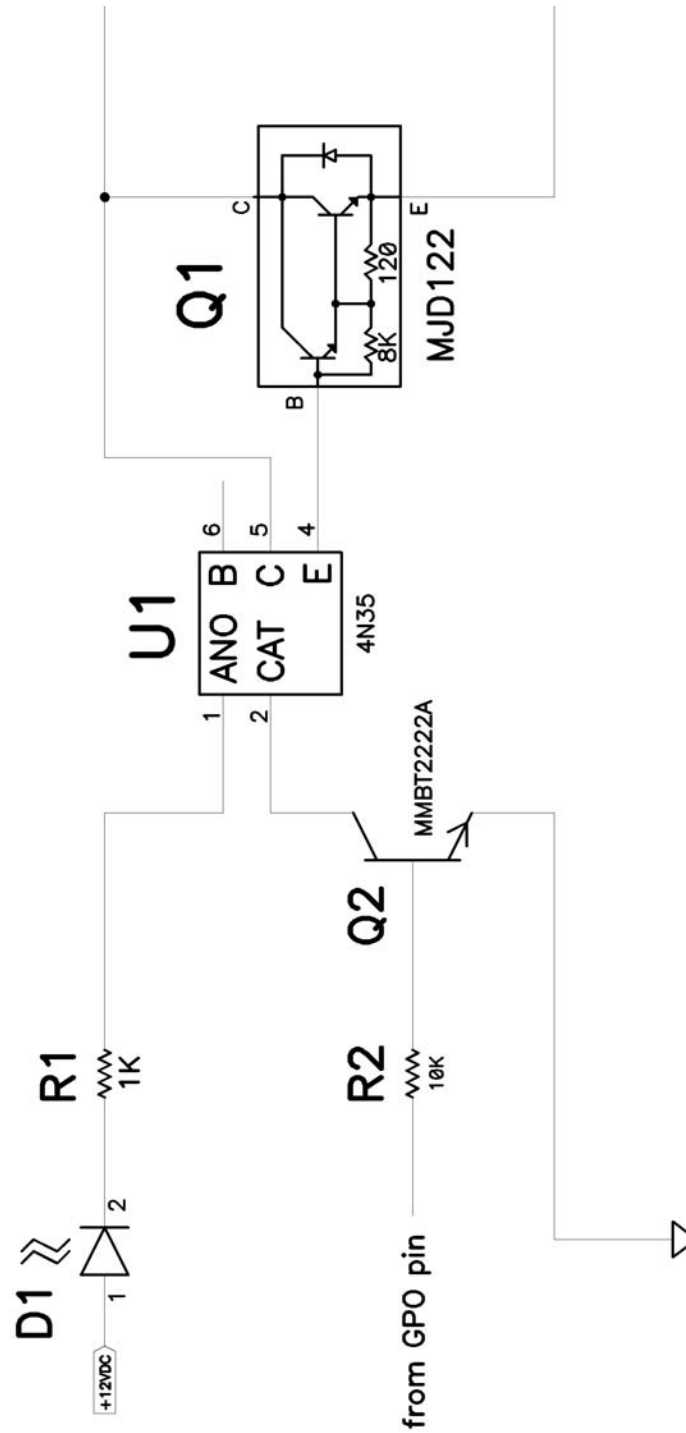
Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	Optoisolator IC, H11AA1S or equivalent	Fairchild	H11AA1S
D2	Diode, 1Amp, 1000V or equivalent	Various	S1M
D1	LED	Various	Various
R1	Resistor, 300 Ohm, 1/8 Watt, 5%	Various	Various
R2	Resistor, 10 K Ohm, 1/8 Watt, 5%	Various	Various
R3, R5	Resistor, 51 K Ohm, 1/2 Watt, Thick Film, 5%	Various	Various
R4	Resistor, 4.7 K Ohm, 1/8Watt, 5%	Various	Various
R6	Resistor, 220 Ohm, 1/10 Watt, 5%	Various	Various
R7	Resistor, 680 Ohm, 1/2 Watt, Thick Film, 5%	Various	Various
C1	Capacitor, 4.7uF, +/-20%, Tantalum, 20V	Various	Various
C2	Capacitor, .1uF, +/-5%, Pen Film, 400V	Panasonic	ECWU4104V17

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8-32 VDC Output

Typical digital output, with an output range of 8-32VDC@ 500mA.

8-32 VDC OUTPUT SCHEMATIC



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Note: +12VDC shown in the Schematic is recommended to be a regulated power supply. This supply should be used internally to the finished product for electrical isolation and to promote noise immunity.

8-32 VDC OUTPUT PARTS LIST

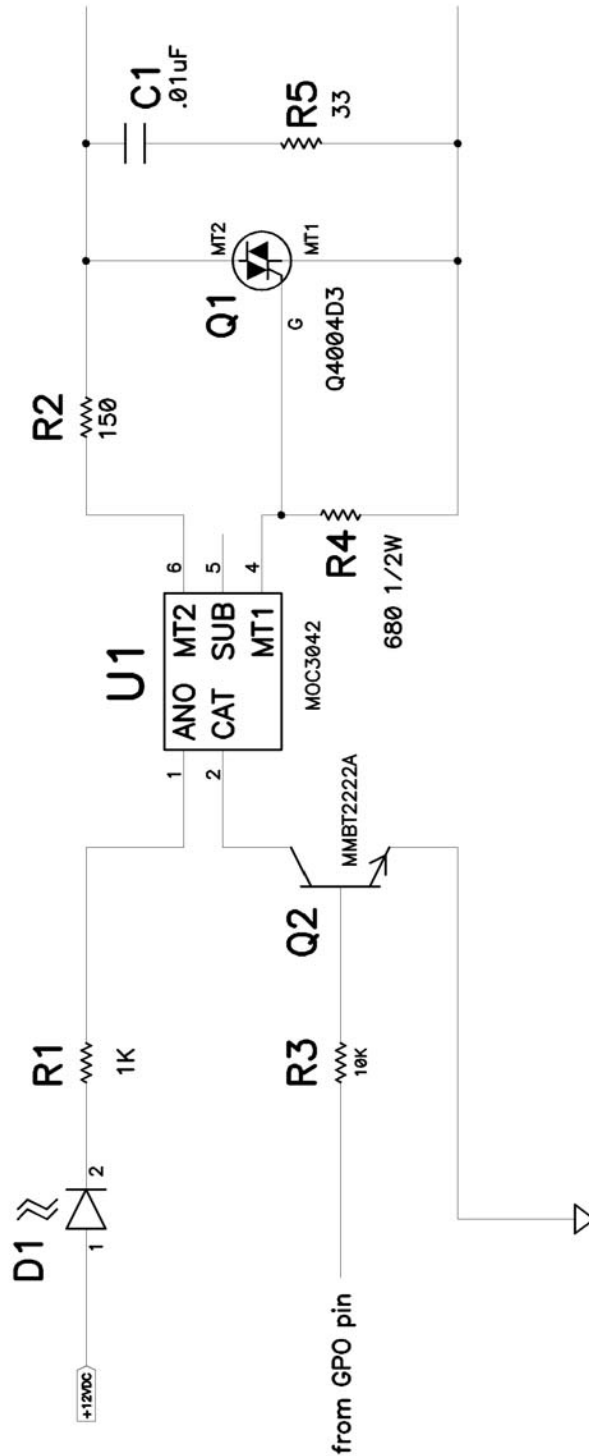
Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	Optoisolator IC, 4N35 or equivalent	Fairchild	4N35SR2-M
D1	LED	Various	Various
R1	Resistor, 1.0K Ohm, 1/2 Watt, 5%	Various	Various
R2	Resistor, 10 K Ohm, 1/8 Watt, 5%	Various	Various
Q1	Transistor, NPN Power Darlington, 8A, 100V	OnSemi	MJD122
Q2	Transistor, MPS2222A or equivalent	Various	Various

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10-120 VAC Output

Typical digital output, with an output range of 10-120VAC @ 500mA.

10-120 VAC OUTPUT SCHEMATIC



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Note: +12VDC shown in the Schematic is recommended to be a regulated power supply. This supply should be used internally to the finished product for electrical isolation and to promote noise immunity.

10-120 VAC OUTPUT PARTS LIST

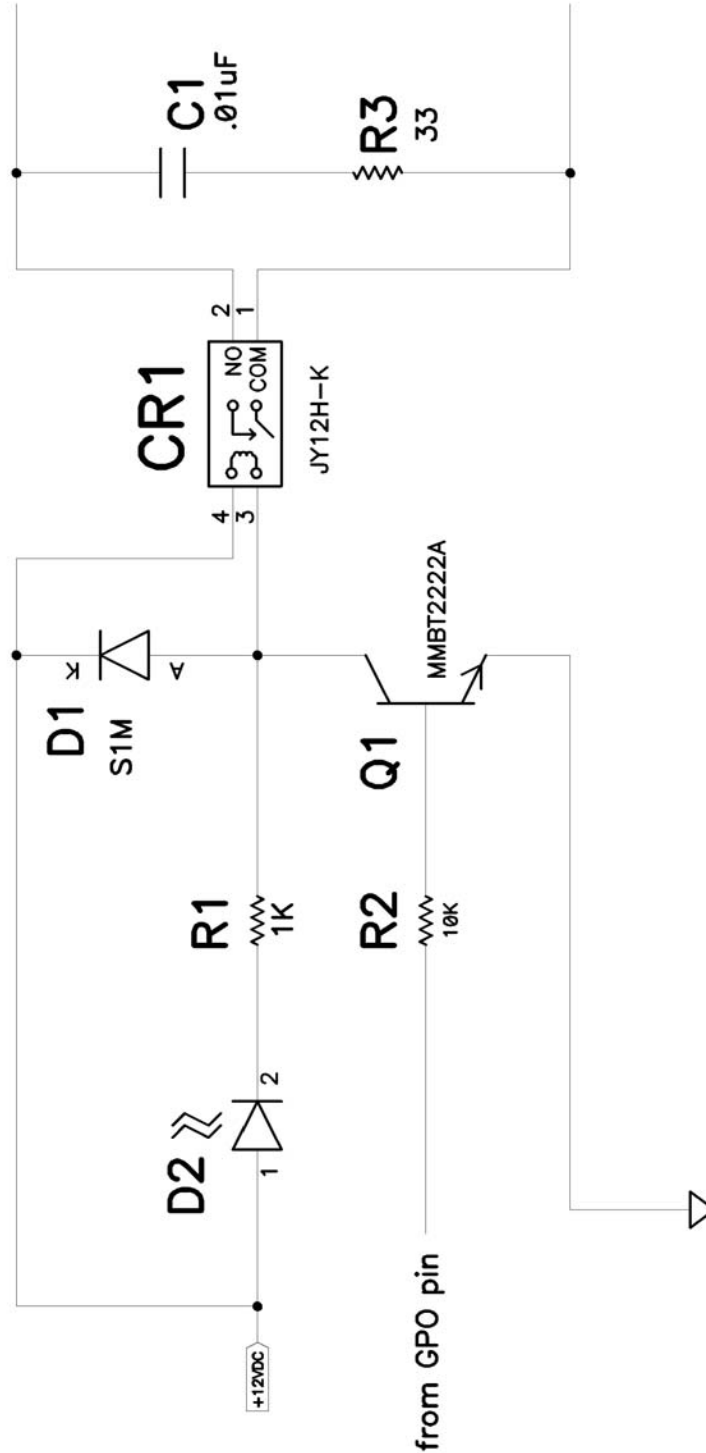
Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	Optoisolator IC, MOC3042 or equivalent	Motorola	MOC3042STR
D1	LED	Various	Various
R1	Resistor, 1.0K Ohm, 1/2 Watt, 5%	Various	Various
R2	Resistor, 150 Ohm, 1/2 Watt, Thick Film, 5%	Various	Various
R3	Resistor, 10 K Ohm, 1/8 Watt, 5%	Various	Various
R4	Resistor, 680 Ohm, 1/2 Watt, Thick Film, 5%	Various	Various
R5	Resistor, 33 Ohm, 1/8 Watt, 5%	Various	Various
Q1	Triac, 4004, 4A, 400V or equivalent	Teccor	Q4004D3
Q2	Transistor, MPS2222A or equivalent	Various	Various
C1	Capacitor, .01uF, +/-5%, Pen Film, 400V	Panasonic	ECWU4103V17

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Relay Output

Typical relay output.

RELAY OUTPUT SCHEMATIC



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Note: +12VDC shown in the Schematic is recommended to be a regulated power supply. This supply should be used internally to the finished product for electrical isolation and to promote noise immunity.

RELAY OUTPUT PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
R1	Resistor, 1.0K Ohm, 1/2 Watt, 5%	Various	Various
R2	Resistor, 10 K Ohm, 1/8 Watt, 5%	Various	Various
R3	Resistor, 33 Ohm, 1/4 Watt, 5%	Various	Various
D1	Diode, 1Amp, 1000V or equivalent	Various	S1M
D2	LED	Various	Various
Q1	Transistor, MPS2222A or equivalent	Various	Various
CR1	Relay, SPST, 12VDC Coil	Takamisawa	JY12H-K
C1	Capacitor, .01uF, +/-5%, Pen Film, 400V	Panasonic	ECWU4103V17

SECTION 5

ANALOG I/O

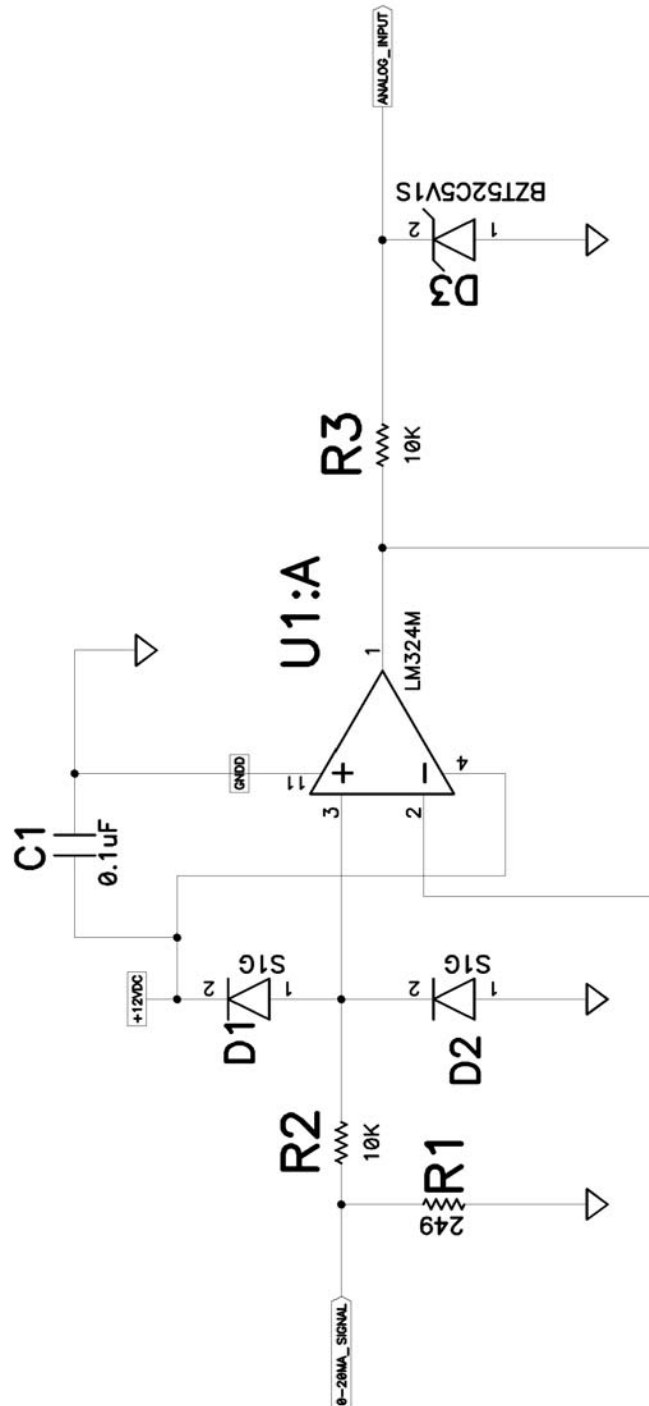


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0-20mA DC Analog Input

Typical analog input circuit for 0-20mA ADC operation.

0-20mA DC ANALOG INPUT SCHEMATIC



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Note: +12VDC shown in the Schematic is recommended to be a regulated power supply. This supply should be used internally to the finished product for electrical isolation and to promote noise immunity.

0-20mA DC ANALOG INPUT PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	Op Amp, 324, Quad or equivalent	National	LM324AN
D1, D2	Diode, 1Amp, 1000V or equivalent	Various	S1M
D3	Diode, 5.1V Zener, 1N4733, +/-10%, 1 Watt	Motorola	1N4733
R1	Resistor, 249 Ohm, 1/8 Watt, .1%	Various	Various
R2, R3	Resistor, 10 K Ohm, 1/8 Watt, 5%	Various	Various
C1	Capacitor, .1uF, -0/+100%, Ceramic, 50V	Various	Various

SECTION 6

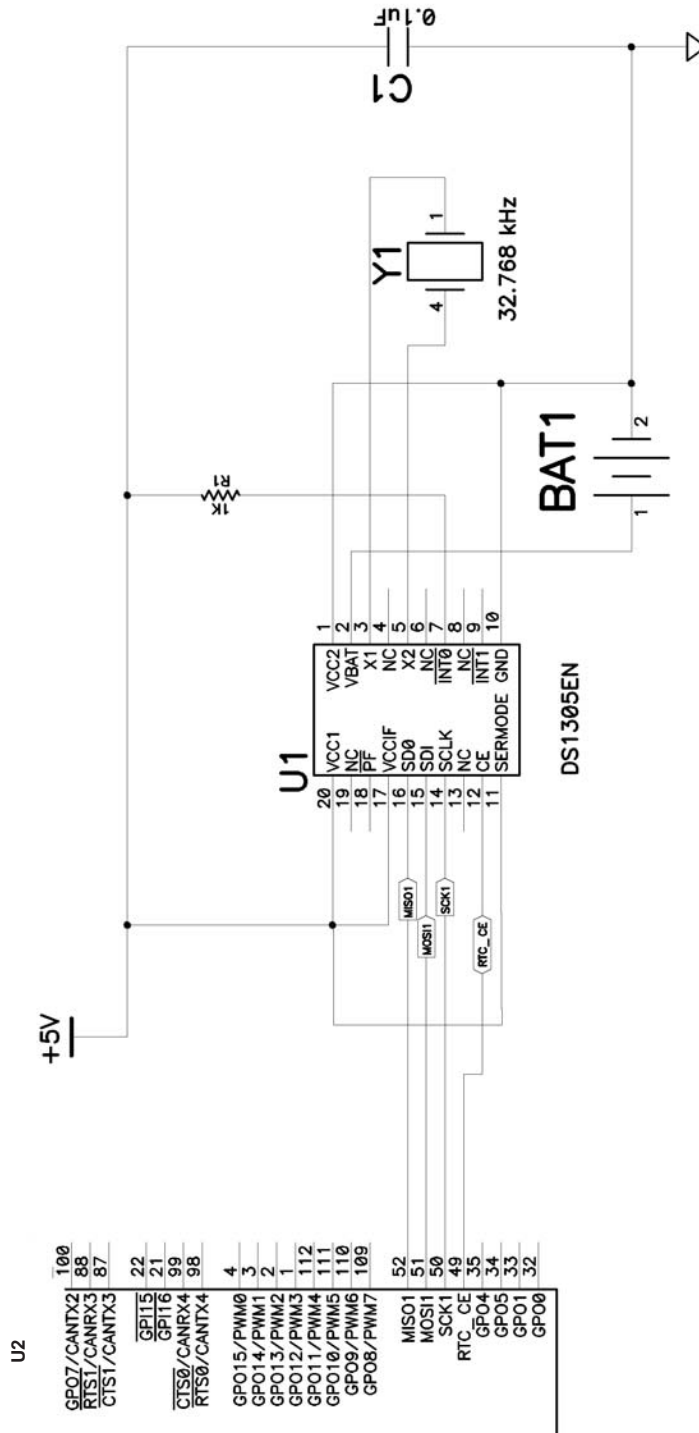
ADDITIONAL CIRCUITS



Real Time Clock

The PLC on a Chip currently supports an interface to a Maxim DS1305 real time clock integrated circuit.

REAL TIME CLOCK SCHEMATIC



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REAL TIME CLOCK PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	Real Time Clock IC * or equivalent	Maxim Semiconductor	DS1305EN
U2	PLC on a Chip IC	Divelbiss Corporation	PLCHIP-M2XXX-X-X
Y1	32.768 KHZ Crystal * or equivalent	FOX	FSR327
R1	Resistor, 1 K Ohm, 1/8 Watt, 5% *	Various	Various
C1	Capacitor, .1uF, +/-20%, Ceramic, 50V *	Various	Various
BAT1	Battery, 160mAH, Lithium Coin * or equivalent	Various	Various

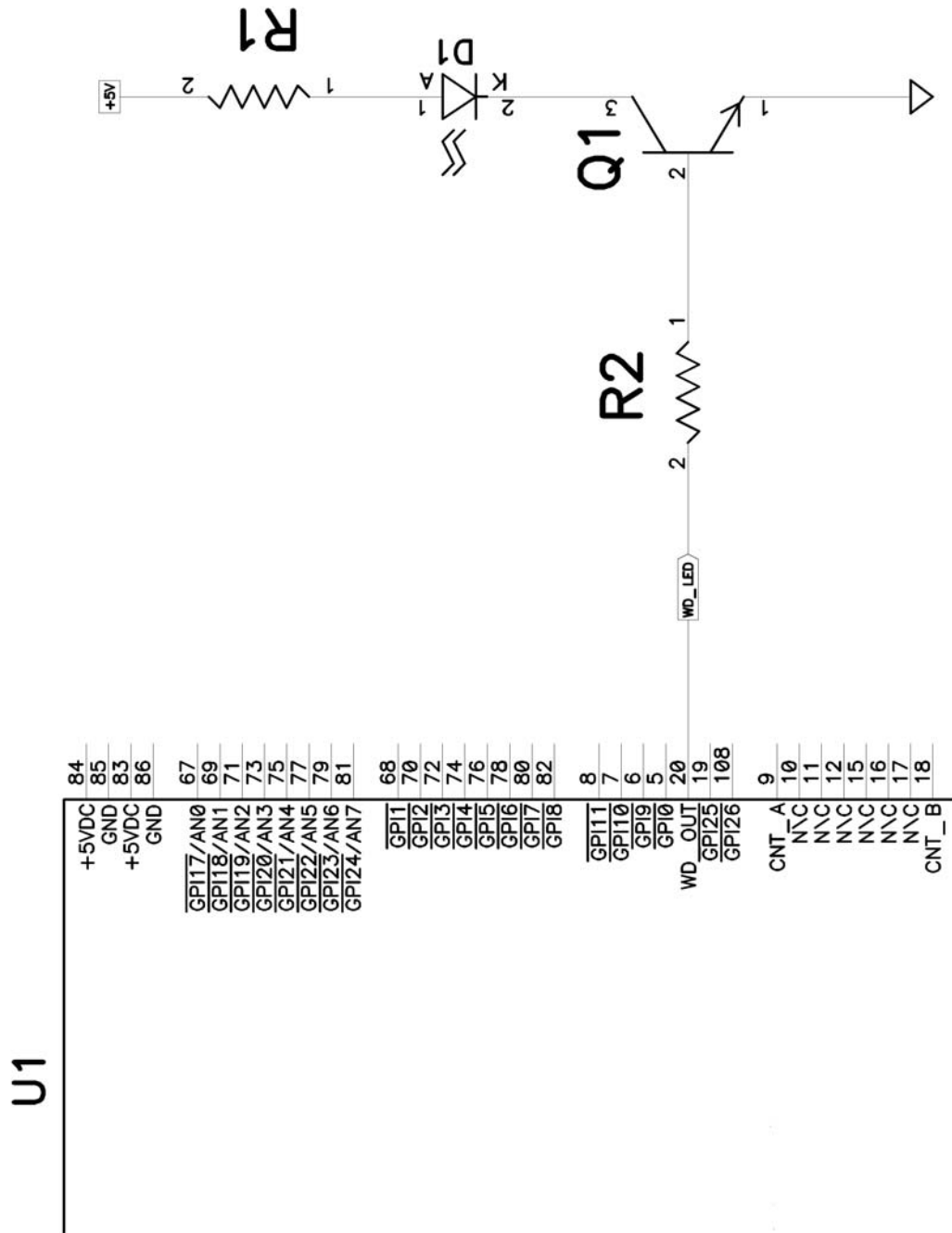
*See DS1305EN Datasheet for details

Refer to the Real Time Clock ICs Manufacturer's Data Sheet for Electrical Specifications

Watchdog Output

If a visual indication of operation of the PLC on a Chip is required, the watchdog pin, as detailed below, can provide this function.

WATCHDOG OUTPUT SCHEMATIC



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WATCHDOG OUTPUT PARTS LIST

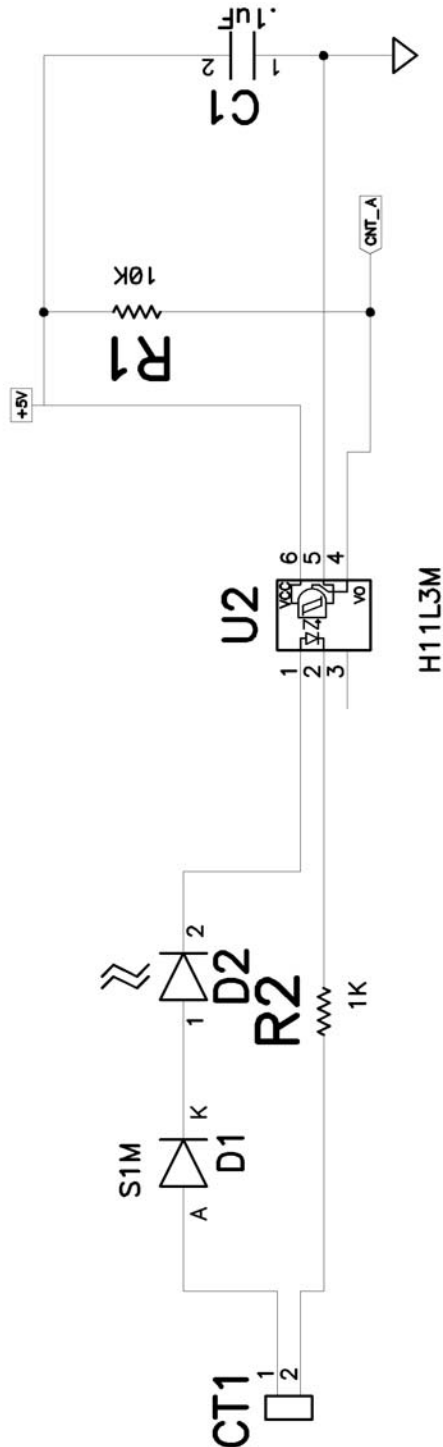
Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	PLC on a Chip IC	Divelbiss Corporation	PLCHIP-M2XXX-X-X
Q1	Transistor, MPS2222A or equivalent	Various	Various
D1	LED	Various	Various
R1	Resistor, 1 K Ohm, 1/8 Watt, 5%	Various	Various
R2	Resistor, 300 Ohm, 1/8 Watt, 5%	Various	Various

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High Speed Counter Input

A typical counter input circuit.

HIGH SPEED COUNTER OUTPUT SCHEMATIC



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HIGH SPEED COUNTER PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
U1	Optoisolator IC, H11L3 or equivalent	Fairchild	H11L3M
D1	Diode, 1Amp, 1000V or equivalent	Various	S1M
D2	LED	Various	Various
R1	Resistor, 10 K Ohm, 1/8 Watt, 5%	Various	Various
R2	Resistor, 1 K Ohm, 1/2 Watt, 5%	Various	Various
C1	Capacitor, .1uF, -0/+100%, Ceramic, 50V	Various	Various
CT1	Connector, 2 Position	Various	Various

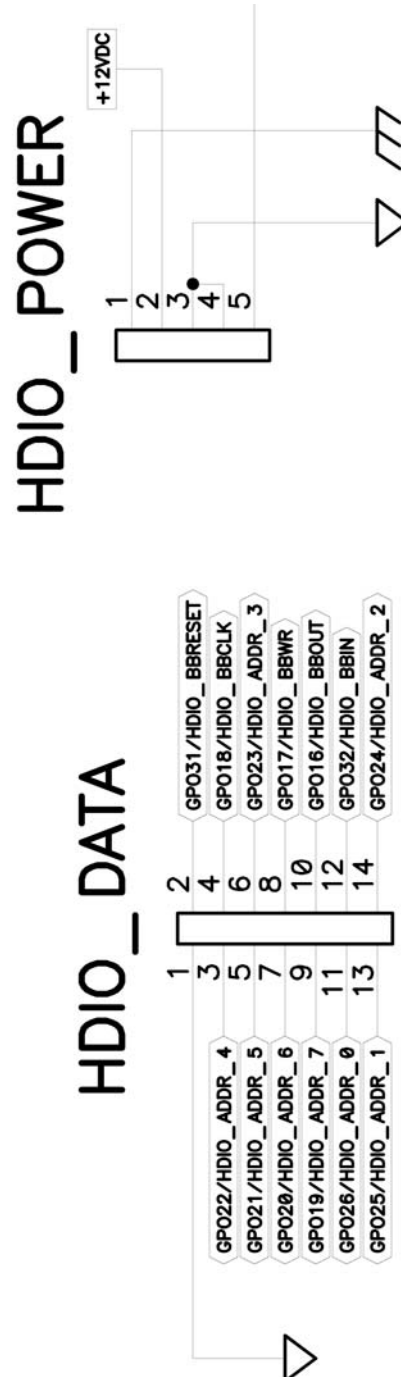
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High Density I/O Interface

The Divelbiss HDIO expansion bus consists of two connectors

- Data Connector (Ansley 609-1424ES or equal)
- Power Connector (Panduit MLSS156-5 or equal)

HIGH DENSITY I/O INTERFACE SCHEMATIC



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HIGH SPEED COUNTER PARTS LIST

Schematic ID	Description	Manufacturer	Manufacturer's Part Number
HDIO_DATA	Connector, 14 Position, Transition Type	Ansley	609-1424ES
HDIO_POWER	Connector, 5 Position, Plug, .156"	Panduit	MLSS156-5

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