



**COP8 COBALT User's Manual  
(COP8 Oriented Breadboard and Learning Tool)  
Prototyping Board for  
COP8™ OTP/ROM**

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## Introduction

The COP8 COBALT (COP8 Oriented Breadboarding and Learning Tool) Prototyping Board is a unique design tool created to aid in the rapid development of applications based on National Semiconductor's COP8 family of 8-bit OTP and ROM microcontrollers. The PC board accommodates all the hardware necessary to prototype, test, and debug a wide variety of microcontroller based applications. The COBALT board is included in the COP8-PRO-COB1 OTP/ROM Prototyping Kit.

## Feature List

- Will accommodate most COP8™ Basic or Feature Family OTP's or Windowed EPROM devices, in 20, 28, or 40 pin DIP packages.
- On-board power conditioning circuitry, and standard barrel-type power connector, accommodates an input power range from 8V-16V AC or DC, regulated or unregulated. The board comes configured for 5v operation, but can optionally be configured for lower volt operation.
- Will accommodate all standard oscillator options (Can, Crystal, Ceramic Resonator, RC, or External Clock). Comes configured with 10MHz crystal oscillator.
- Data-book compliant RESET circuit, with pushbutton RESET switch.
- Onboard 9pin Serial connector, with layout for optional RS232 port driver IC. Comes configured for MicroWire/PLUS.
- Layout for optional Serial EEPROM via MICROWIRE\PLUS.
- 10 Current Limited LED's mounted on board for simple display interface. LED mounting holes will also accommodate a discrete PNP transistor for higher current drive on the first 8 LEDs.
- 8 Pushbutton input switches.
- Six output port connections to drive hobby-style servomotors, or external devices.
- 40-pin port expansion connector for easy addition of daughter cards.
- A 2"x4" prototyping breadboard area is available for building additional circuitry directly onto the board. Mounting holes in the prototyping area will accommodate a standard Plug-In Prototyping board for training, circuit analysis, or rapid design changes.
- Board size is designed to mount directly into a Lansing C-Series, T-width chassis. Lansing Instrument Corporation, PO Box 730, Ithaca, NY, 14851-0730, 1-800-847-3535

## COP8 COBALT Board Feature Details

### **Supports COP8 OTP/EPROM devices in 20/28/40 pin DIP**

- The board comes configured with a 40DIP socket (U1), populated with a pre-programmed, erasable COP8SGR740Q3 40pin device. This device is a super-set device for many of the COP8 OTP/ROM families. The same socket will also support 28 or 40 DIP devices for COP8SA/SE/AJ/AK Families, and most COP87Lxx OTP's. Space is available for an optional 20 DIP socket.

### **Power Supply**

- The COBALT board comes configured with a standard TO-220 type 5v regulator (U5), and accepts 8v-16v AC or DC inputs through a standard 1/8" Barrel -type power connector (J3). The full wave bridge rectifier following the connector (D1-D4) allows AC adapters to be used as well as DC adapters of either positive-center or negative-center polarity.
- Input filtering is accomplished with capacitor C6 and output filtering with capacitor C7. A smaller T0-92 type regulator can be substituted at U5 for lower power applications. A jumper is also provided for the addition of an external power switch. To use an external power switch, a trace on the bottom of the board will need to be cut between the two terminals of the jumper.
- LED9 is the Power LED, and should be ON when power is applied. Additionally, with the pre-programmed COP8SGR740Q3 device installed, LEDs 1-8 will flash sequentially if the board is operating properly.

### **Oscillator Options**

- The board comes configured for 10MHz Crystal Oscillator mode. Only one option at a time is allowable.
  1. **RC Oscillator Mode (JP2=RC):** R2 and C10 form the RC network. With R2=6.8K, and C10=100pF, a Clock frequency of approximately 5 MHz is created. Refer to the Tables in the COP8™ data book for more detailed information.
  2. **Crystal/Ceramic Resonator Mode:** In this mode, C9, C10, X1, and R2 form the oscillator network. X1 can be either a crystal, or a ceramic resonator. The Maximum allowable crystal frequency is 15Mhz, depending on the COP8 being used.
  3. **Can Oscillator:** Provisions exist for a standard 4-pin can oscillator.
  4. **External Oscillator:** Connector J4 is provided to allow easy interface to an external oscillator source so that the COBALT board can be synchronized with an external processor.

|            | <b>RC</b> | <b>Crystal</b> | <b>Can</b> | <b>External</b> |
|------------|-----------|----------------|------------|-----------------|
| <b>JP2</b> | RC        | XT             | Open       | Open            |
| <b>J4</b>  | Open      | Open           | Open       | Short           |

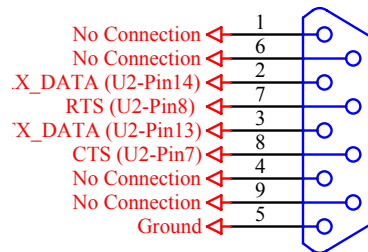
Continued...

## Reset Circuit

- The COBALT board comes configured with a pushbutton RESET switch (SW9), and implements the recommended reset circuit shown in the COP8™ Data book (R3. C11. D5).
- The R3/C11 rise-time constant can be modified as required, but the designated values will be sufficient for most applications.

## MicroWire\PLUS and RS232 Communications Interfaces

- For applications requiring communication with a PC or other external equipment, the board comes configured for a MicroWire\PLUS interface via PCB pin connections (most COP8 devices have on-chip MicroWire\PLUS capability).
- The board also includes an inactive 9-pin D-sub female connector (J1-DCE), which can be connected to the MicroWire\PLUS circuitry, or configured for optional RS232 communications. Layout is provided for an RS-232 driver IC (U2). C1-C4 provide the voltage generation.
- Note that some feature family parts (COP8SG for example) have hardware UARTS. Other devices will require a software UART implementation (refer to the source code files on the COP8 CD for driver code).



RS-232 DCE Connector Pinout

## Serial EEPROM

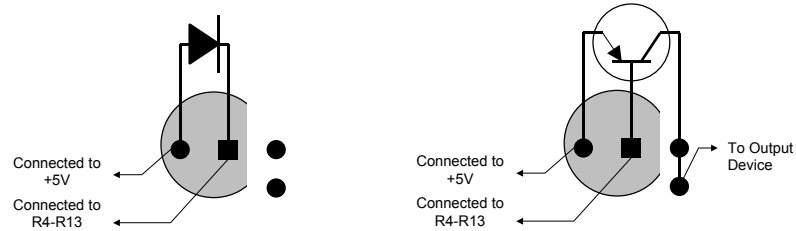
- U3 is the optional Serial EEPROM device, which can be used to store look-up tables, program data, or a other application-specific information. Interface to the COP8 is via the MICROWIRE™ \PLUS interface, with port pin G4 serving as the chip select.
- All of National's NM93CXX Serial EEPROM family of MICROWIRE™ Bus Interface devices parts are supported, including devices which have the ORG pin to allow the data to be organized as 8-bit or 16-bit words (selected by JP3). Refer to National Semiconductor's Data books for detailed timing information on these devices.

| JP3          | IN  | OUT             |
|--------------|-----|-----------------|
| ORG FUNCTION | x 8 | x 16 (NM93C46A) |

## LED Outputs

- 10 general purpose LED's, driven through 330-ohm current limiting resistors, are available for simple display needs. LED1-LED8 are connected to the Port D0-D7 I/O pins, and LED10-LED11 are connected to the Port L0-L1 I/O pins (note that the D and L ports are only available on the 40 pin parts). Continued.....

- To use these LED's with the 16/20/28 pin parts, connections to the LED's can be made from the expansion header adjacent to the bread boarding area.
- Note also that the LED mounting holes will also accommodate a PNP output transistor for applications that require additional current drive.



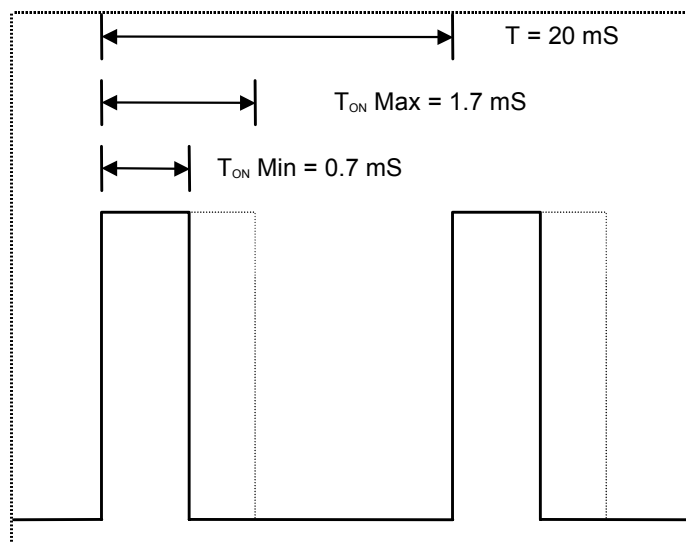
Connection Diagram for LED Outputs (LED1-11)

## Pushbutton Switch Inputs

- 8 simple, momentary pushbutton switches (SW1-8) are connected between the device's F Port inputs and ground. (note that the F ports are only available on the 40 pin parts).

## Servo Motor Ports

- 6 Servo Output pin connections (Servos 1-6) are driven by the Port L4-L7 and C0-C1 pins, respectively. These general purpose, powered interface connections can be used to drive standard hobby servo motors. These motors use a fixed period, variable pulse width input to vary the rotational angle of the servo. C12 and 13 are located near these pins to provide additional supply bypassing (see errata notes concerning the silkscreen labels of C12 and C13).



Typical Servo Motor Waveform

## Breadboard Area with Expansion Header

- The 2"x4" Breadboard area is for the addition of user-defined circuitry. Power is available through pins at the periphery labeled +5V and GND (power is also available through the expansion connector).

- The four mounting holes in the breadboard area will accommodate a standard plug board for training or rapid prototyping. Additionally, these holes can be used to support a daughter card mated to the expansion connector, extending the design area. This is useful if the additional circuitry requires electrical or physical isolation for noise immunity.

## Expansion Connector

- The expansion connector is a 40-pin berg header, which brings out the functional COP8 pins, including CKI, +5V and GND. A female header is easily attached for interfacing to a daughter board, or off-board applications. Note that the silk screen on the board is only for the 40-pin device. The table below gives the Port I/O pin connections for the other devices.

| Expansion Connector Pin | 40-pin Device | 28 Pin Device | 20 pin Device | Peripherals            |
|-------------------------|---------------|---------------|---------------|------------------------|
| 1                       | C1            | NC            | NC            | Servo Port 6           |
| 2                       | C0            | NC            | NC            | Servo Port 5           |
| 3                       | G3/TIO        | G3/TIO        | G3/TIO        |                        |
| 4                       | G2            | G2            | G2            |                        |
| 5                       | G1            | G1            | G1            |                        |
| 6                       | G0            | G0            | G0            | External Interrupt Pin |
| 7                       | RESET         | RESET         | RESET         | RESET                  |
| 8                       | GROUND        | GROUND        | GROUND        | GROUND                 |
| 9                       | D7            | D3            | L7            | R4/LED8                |
| 10                      | D6            | D2            | L6            | R5/LED7                |
| 11                      | D5            | D1            | L5            | R6/LED6                |
| 12                      | D4            | D0            | L4            | R7/LED5                |
| 13                      | D3            | L7            | NC            | R8/LED4                |
| 14                      | D2            | L6            | NC            | R9/LED3                |
| 15                      | D1            | L5            | NC            | R10/LED2               |
| 16                      | D0            | L4            | NC            | R11/LED1               |
| 17                      | L7            | NC            | NC            | Servo Port 4           |
| 18                      | L6            | NC            | NC            | Servo Port 3           |
| 19                      | L5            | NC            | NC            | Servo Port 2           |
| 20                      | L4            | NC            | NC            | Servo Port 1           |
| 21                      | L3            | NC            | NC            | RX_DATA (RS-232)       |
| 22                      | L2            | NC            | NC            | TX_DATA (RS-232)       |
| 23                      | L1            | NC            | NC            | RTS (RS-232)           |
| 24                      | L0            | NC            | NC            | CTS (RS-232)           |
| 25                      | F7            | L3            | NC            |                        |
| 26                      | F6            | L2            | NC            |                        |
| 27                      | F5            | L1            | NC            |                        |
| 28                      | F4            | L0            | NC            |                        |
| 29                      | F3            | F3            | L3            |                        |
| 30                      | F2            | F2            | L2            |                        |
| 31                      | F1            | F1            | L1            |                        |
| 32                      | F0            | F0            | L0            |                        |
| 33                      | +5 VOLT       | +5 VOLT       | +5 VOLT       | +5 VOLT                |
| 34                      | CKI           | CKI           | CKI           | J4 - PIN1 (EXT. OSC.)  |
| 35                      | G7/CKO        | G7/CKO        | G7/CK0        |                        |
| 36                      | G6/SI         | G6/SI         | G6/SI         |                        |
| 37                      | G5/SK         | G5/SK         | G5/SK         |                        |
| 38                      | G4/SO         | G4/SO         | G4/SO         |                        |
| 39                      | C3            | NC            | NC            | EEPROM Chip Select     |
| 40                      | C2            | NC            | NC            | Microwire Chip select  |

## Standard Box Enclosure for a Finished Target Application

- Lansing C-Series, T-width chassis. Lansing Instrument Corporation, PO Box 730, Ithaca, NY, 14851-0730, 1-800-847-3535

## Parts List for COP8 COBALT Board:

| *Note: This is a common part. Supplier and Part Number may vary.   |      |                |           |   |                              |
|--|------|----------------|-----------|---|------------------------------|
| **Note: This part has second sources. Specifications are not critical. Similar parts may be substituted. |      |                |           |   |                              |
| Item   | Qty. | Part Number    | Supplier  | Part Description                        | Designators                  |
| *1   | 4    | P2036-ND       | DIGIKEY   | 4.7 uF, 16V TANTALUM, RADIAL            | C1,C2,C3,C4                  |
| *2   | 1    | P2040-ND       | DIGIKEY   | 22 uF, 16V TANTALUM, RADIAL             | C11                          |
| *3   | 1    | 1210PHCT-ND    | DIGIKEY   | 0.1 uF, 50V CERAMIC, AXIAL              | C8                           |
| *4   | 2    | P6251-ND       | DIGIKEY   | 47 uF, 35V ELECTROLYTIC, RADIAL         | C6,C7                        |
| *5   | 2    | P4843-ND       | DIGIKEY   | 33 pF, CERAMIC, RADIAL                  | C9,C10                       |
| *6   | 1    | S2212-20-ND    | DIGIKEY   | 2 X 20 0.1 sp PIN HEADER                | CON1                         |
| **7  | 4    | 1N4001CT-ND    | DIGIKEY   | 1N4001 GP DIODE                         | D1,D2,D3,D4                  |
| **8  | 1    | 1N4148CT-ND    | DIGIKEY   | 1N4148 SIGNAL DIODE                     | D5                           |
| *9   | 1    | A2100-ND       | DIGIKEY   | DB-9 90 Degree PCB MOUNT FEMALE         | J1                           |
| *10  | 1    | CP-002A-ND     | DIGIKEY   | AC ADAPTER POWER CONN.                  | J3                           |
| *11  | 7    | S1212-03-ND    | DIGIKEY   | 1 X 3, 0.1 sp PIN HEADER                | JP2, SERVO1-6                |
| *12  | 2    | S1212-02-ND    | DIGIKEY   | 1 X 2, 0.1 sp PIN HEADER                | JP3,J4                       |
| **13   | 11   | LT1095-ND      | DIGIKEY   | GP GREEN LED                            | LED1-LED11                   |
| *14  | 2    | 10.0KXBK-ND    | DIGIKEY   | 10 K OHM, 1/4 WATT, 1%                  | R1,R3                        |
| *15  | 1    | 1.00MXBK-ND    | DIGIKEY   | 1 M OHM, 1/4 WATT, 1%                   | R2                           |
| *16  | 11   | 332XBK-ND      | DIGIKEY   | 330 OHM, 1/4 WATT, 1%                   | R4-R14                       |
| *17  | 9    | P8080SCT-ND    | DIGIKEY   | PUSH BUTTON SWITCH                      | RESET, SW1-SW8               |
| *18  | 1    |                | DIGIKEY   | 40 pin DIP socket, 600 mil, low profile | U1                           |
| 19   | 1    | COP8SGE740N8/7 | NSC       | COP8 MICROCONTROLLER                    | U1 (Install in socket at U1) |
| 20   | 0    | N/R            | NSC       | RS-232 INTERFACE                        | U2                           |
| **21   | 0    | N/R            | FAIRCHILD | EEPROM SERIAL MEMORY                    | U3                           |
| **23   | 1    | LM340CT-5      | NSC       | 5 V LDO REGULATOR                       | U5 (Screw mount not needed)  |
| **24   | 1    | CTX057-ND      | DIGIKEY   | 10.000 MHZ CRYSTAL OSCILLATOR           | X1                           |
| 25   | 1    | N/R            | NSC       | COBALT V2.00 PCB                        | PCB1 (See errata below)      |
| *26  | 4    | 1902CK-ND      | DIGIKEY   | 0.5" LONG 4-40 NYLON SPACER             | Mount on bottom 4 corners    |
| *27  | 4    | H544-ND        | DIGIKEY   | 4-40 NYLON SCREW 3/8 "                  |                              |
| *28  | 2    | S9000-ND       | DIGIKEY   | 0.1" sp SHUNTS                          | JP2=XT, JP4                  |
| *29  | 2    |                | DIGIKEY   | 100 uF, 35V ELECTROLYTIC, RADIAL        | C12, C13 (See errata below)  |
|  |      |                |           |   |                              |
|  |      |                |           |   |                              |

## Errata and Known Bugs

- **Errata # 1 – C9 and C10 show up twice on silk screen.**

Capacitors C9 and C10 near the Oscillator section (X1) should be 33pf. C9 and C10 near SERVOS should be 100uF, and are referred to C12 and C13 in the BOM item #29.

- **Errata # 2 – There is no C5 on silk screen. It does not exist.**

- **Errata # 3 – JP1 is not marked on silk screen.**

JP1 is the jumper for the optional Power Switch (next to J3, POWER). It is shorted on the PCB, and the trace must be cut before installing and using JP1.

- **Errata # 4 – CON1 is not marked on silk screen.**

CON1 is the 40 pin header next to U1. Continued.....

- ***Errata # 5 – JP5 is not used.***

JP5 is not used on the PCB.

- ***Errata # 6 – U1 has two components.***

U1 location is first stuffed with a 40 DIP socket (BOM #18), then the COP8 (BOM #19) is inserted last.

## **CREDITS:**

This version of this document was edited by Dave Katra, but is based on an original document and information created by Chris Glowacki and Rick Zarr.

The COBALT board was created and designed by Chris Glowacki and Rick Zarr.

# Schematic Diagram for COBALT Board

