National Semiconductor

COP842CMH
Microcontroller Emulator

General Description

The COP842CMH hybrid emulator is a member of the COPS™ microcontroller family. The device is a two chip system in a dual cavity 20-pin DIP package. Within the package is the COP842C and a UV-erasable 8k EPROM with port recreation logic. Code executes out of the EPROM. The part contains a transparent window which allows the EPROM to be erased and re-programmed. The COP842CMH is a fully static part, fabricated using double-metal silicon gate microCMOS technology. Features include an 8-bit memory mapped architecture, MICROWIRE/PLUS™ serial I/O, and a 16-bit timer/counter supporting three modes (PWM generation, External Event counter, and Input Capture). Each I/O pin has software selectable configurations. The COP842CMH operates over a voltage range of 4.5V to 6.0V. High throughput is achieved with an efficient, regular instruction set operating at a maximum of 1 μs per instruction rate.

The COP842CMH is primarily intended as a prototyping design tool. The Electrical Performance Characteristics are not tested but are included for reference only.

Features

- Form fit and function emulation device for the COP842C/COP822C
- Fully static CMOS
- 1 μs instruction time (10 MHz clock)
- 8191 bytes EPROM/128 bytes RAM
- 16-bit read/write timer operates in a variety of modes
  - — Timer with 16-bit auto reload register
  - — 16-bit external event counter
  - — Timer with 16-bit capture register (selectable edge)
- Multi-source interrupt
  - — External interrupt with selectable edge
  - — Timer/capture interrupt
  - — Software interrupt
- 8-bit stack pointer (stack in RAM)
- Powerful instruction set, most instructions are single byte
- BCD arithmetic instructions
- MICROWIRE/PLUS serial I/O
- 20-pin package
- 16 input/output pins
- Software selectable I/O options (TRI-STATE®, push-pull, weak pull-up)
- Schmitt trigger inputs on Port G
- Real time emulation and full program debug offered by National's Development Systems

Ordering Information

Hybrid Emulator	Package Type	Part Emulated
COP842CMHD-x	20-Pin DIP	COP822C-XXX/N COP842C-XXX/N

x = 1, 2, or 3. See "Oscillator Circuits".
1 = Crystal ÷ 10
2 = External ÷ 10
3 = R/C ÷ 10

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})	7V
Reset (V_{PP}) and G6 (ME)	−0.3V to 14V
Voltage at any other Pin	−0.3V to V_{CC} + 0.3V
Total Current into V_{CC} Pin (Source)	50 mA
Total Current Out of GND Pin (Sink)	60 mA
Storage Temperature Range	−65°C to +140°C

Note: Absolute maximum ratings indicate limits beyond which damage to the device may occur. DC and AC electrical specifications are not ensured when operating the device at absolute maximum ratings.

The following AC and DC Electrical Characteristics are not tested but are for reference only.

DC Electrical Characteristics −0°C < T_A < +70°C unless otherwise specified

Parameter	Conditions	Min	Typ	Max	Units
Operating Voltage		4.5		6.0	V
Power Supply Ripple (Note 1)	Peak to Peak			0.1 V_{CC}	V
Supply Current					
CKI = 10 MHz	V_{CC} = 6.0V, t_c = 1 μs			19	mA
CKI = 5 MHz	V_{CC} = 6.0V, t_c = 2 μs			14	mA
(Note 2)					
HALT Current (Note 3)	V_{CC} = 6.0V, CKI = 0 MHz		500		μA
INPUT LEVELS					
Reset, CKI					
Logic High		0.9 V_{CC}			V
Logic Low				0.1 V_{CC}	V
All Other Inputs					
Logic High		0.7 V_{CC}			V
Logic Low				0.2 V_{CC}	V
Hi-Z Input Leakage	V_{CC} = 6.0V	−2		+2	μA
Input Pullup Current	V_{CC} = 6.0V	40		250	μA
G Port Input Hysteresis			0.05 V_{CC}		V
Output Current Levels					
D Outputs					
Source	V_{CC} = 4.5V, V_{OH} = 3.8V	0.4			mA
Sink	V_{CC} = 4.5V, V_{OL} = 1.0V	10			mA
All Others					
Source (Weak Pull-up Mode)	V_{CC} = 4.5V, V_{OH} = 3.2V	10		110	μA
Source (Push-pull Mode)	V_{CC} = 4.5V, V_{OH} = 3.8V	0.4			mA
Sink (Push-pull Mode)	V_{CC} = 4.5V, V_{OL} = 0.4V	1.6			mA
TRI-STATE Leakage		−2.0		+2.0	μA
Allowable Sink/Source Current Per Pin				3	mA
Maximum Input Current without Latchup (Note 4)	Room Temp			±100	mA
RAM Retention Voltage, V_R	500 ns Rise and Fall Time (Min)	2.0			V
Input Capacitance				7	pF

Note 1: Rate of voltage change must be less than 0.5V/ms.

Note 2: Supply current is measured after running 2000 cycles with a square wave CKI input, CKO open, inputs at rails and outputs open.

Note 3: The HALT mode will stop CKI from oscillating in the RC and the Crystal configurations. HALT test conditions: L and G ports are at TRI-STATE and tied to ground, EPROM window covered.

Note 4: Pins G6 and $\overline{\text{RESET}}$ are designed with a high voltage input network for factory testing. These pins allow input voltages greater than V_{CC} and the pins will have sink current to V_{CC} when biased at voltages greater than V_{CC} (the pins do not have source current when biased at a voltage below V_{CC}). The effective resistance to V_{CC} is 750Ω (typical). These two pins will not latch up. The voltage at the pins must be limited to less than 14V.

AC Electrical Characteristics $-0°C < T_A < +70°C$ unless otherwise specified

Parameter	Conditions	Min	Typ	Max	Units
Instruction Cycle Time (tc)					
Crystal/Resonator	$V_{CC} \geq 4.5V$	1		DC	μs
(Div-by 10)					
R/C Oscillator Mode	$V_{CC} \geq 4.5V$	3		DC	μs
(div-by 10)					
CKI Clock Duty Cycle		40		60	%
(Note 5)					
Rise Time (Note 5)	fr = 10 MHz ext clock			12	ns
Fall Time (Note 5)	fr = 10 MHz ext clock			8	ns
MICROWIRE™ Setup Time (tUWS)		20			ns
MICROWIRE Hold Time (tUWH)		56			ns
MICROWIRE Output Propagation Delay (tUPD)				220	ns
Input Pulse Width					
Interrupt Input High Time		1			tC
Interrupt Input Low Time		1			tC
Timer Input High Time		1			tC
Timer Input Low Time		1			tC
Reset Pulse Width		1.0			μs

Note 5: Parameter sampled (not 100% tested).

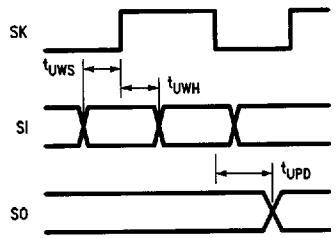

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FIGURE 1. MICROWIRE Timing Diagram

Pin Descriptions

ON CHIP I/O

V_{CC} and GND are the power supply pins.

CKI is the clock input. This can come from an external source, a R/C generated oscillator or a crystal (in conjunction with CKO).

RESET is the master reset input.

Port L is an 8-bit I/O port.

There are two registers associated with the L port: a data register and a configuration register. Therefore, each L I/O bit can be individually configured under software control as shown in the following table:

Configure	Data	Port L Setup
0	0	Hi-Z Input (TRI-STATE Output)
0	1	Input with Pull-Up (Weak One Output)
1	0	Push-Pull Zero Output
1	1	Push-Pull One Output

Three RAM data memory locations are allocated for the L port, one for the data register, one for the configuration register and one for the input pins.

Port G is an 8-bit port with 6 I/O pins (G0–G5) and 2 input pins (G6, G7). All eight G-pins have Schmitt Triggers on the inputs.

There are two registers associated with the G port: a data register and a configuration register. Therefore, each G port bit can be individually configured under software control as shown below:

Configure	Data	Port G Setup
0	0	Hi-Z Input (TRI-STATE Output)
0	1	Input with Pull-Up (Weak One Output)
1	0	Push-Pull Zero Output
1	1	Push-Pull One Output

Three RAM data memory locations are allocated for the G port, one for the data register, one for the configuration register, and one for the input pins.

Since G6 and G7 are input only pins, any attempt by the user to configure them as outputs by writing a one to the configuration register will be disregarded. Reading the G6 and G7 configuration bits will return zeros. Note that the COP842CMH will be placed in the HALT mode by setting the G7 data bit.

Six Port G pins have alternate functions:

G0 INT (External Interrupt)

G3 TIO (Timer/Counter I/O)

G4 SO (MICROWIRE Serial Data Output)

G5 SK (MICROWIRE Serial Clock)

G6 SI (MICROWIRE Serial Data Input)

G7 CKO Crystal Oscillator Output (Selected by Mask Option) or HALT Restart Input (General Purpose Input)

TABLE I. COP842CMH Pinouts for 20-Pin Package

Port	Type	Alternate Function	20-Pin DIP
L0	I/O		7
L1	I/O		8
L2	I/O		9
L3	I/O		10
L4	I/O		11
L5	I/O		12
L6	I/O		13
L7	I/O		14
G0	I/O	INT	17
G1	I/O		18
G2	I/O		19
G3	I/O	TIO	20
G4	I/O	SO	1
G5	I/O	SK	2
G6	I	SI	3
G7	I/CKO	HALT RESTART	4
VCC			6
GND			15
CKI			5
$\overline{\text{RESET}}$			16

Connection Diagram

20 DIP

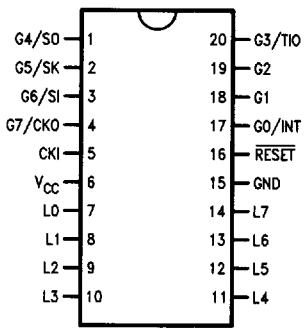

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FIGURE 2. COP842CMH Connection Diagram

Note: See COP842C datasheet for complete details.

Connection Diagram (Continued)

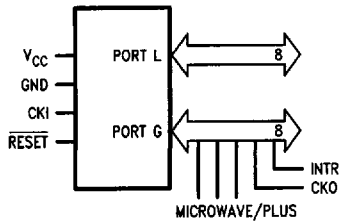

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FIGURE 3. COP842CMH Function Diagram

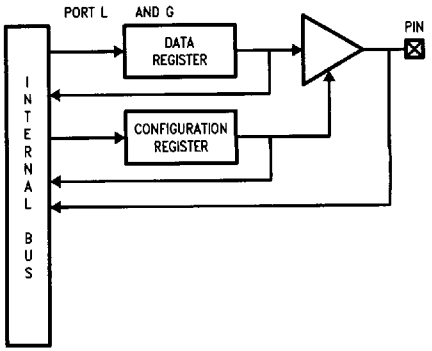

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FIGURE 4. I/O Port Configurations

Oscillator Circuits

A. CRYSTAL OSCILLATOR—COP842CMHD-1

By selecting CKO as a clock output, CKI and CKO can be connected to make a crystal controlled oscillator. See Table II for value of R & C.

B. EXTERNAL OSCILLATOR—COP842CMHD-2

CKI can be driven by an external clock signal provided it meets the specified duty cycle, rise and fall times, and input levels. CKO (G7) is available as a general purpose input and/or Halt Control.

C. R/C OSCILLATOR—COP842CMHD-3

CKI is configured as a single pin R/C controlled Schmitt trigger oscillator. CKO (G7) is available as a general purpose input and/or HALT restart control.

Table III shows the variation in the oscillator frequencies as functions of the component (R and C) values.

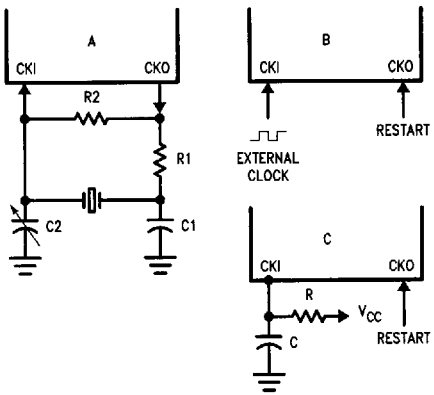

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FIGURE 6. Crystal, External, and R-C Oscillator Diagrams

TABLE II. Crystal Oscillator Configuration, $T_A = 25°C$, $V_{CC} = 5V$

R1 (kΩ)	R2 (MΩ)	C1 (pF)	C2 (pF)	CKI Freq. (MHz)
0	1	30	30–36	10
0	1	30	30–36	4
0	1	200	100–150	0.455

TABLE III. RC Oscillator Configuration, $T_A = 25°C$, $V_{CC} = 5V$

R (kΩ)	C (pF)	CKI Freq. (MHz)	Instr. Cycle (μs)
3.3	82	2.8 to 2.2	3.6 to 4.5
5.6	100	1.5 to 1.1	6.7 to 9
6.8	100	1.1 to 0.8	9 to 12.5

Programming the COP842CMH

Programming the COP842CMH hybrid emulators is accomplished through the duplicator board which is a stand alone programmer capable of supporting different package types. It works in conjunction with a pre-programmed EPROM (either via the development system or a standard programmer) holding the application program. The duplicator board essentially copies the information in the EPROM into the hybrid emulator.

The last byte of program memory (EPROM location 01FFF Hex) must contain the value 0E7 Hex. The device will not function properly if any other value resides in this last byte's location.

The following product codes are used by the customer to order the duplicator board.

NSID	Description	Documentation
COP8-RRGM-DIP	Duplicator Board for 20-Pin DIP	User Instruction Manual

The device will also program on a Data I/O Programmer. The following table provides the programming information on a Data I/O Programmer.

COPs Part Number	Package Type	Family Code	Pin	Software Rev	Adapter
COP842CMHD	20 DIP	16F	174	V3.2	SITE48

ERASING THE COP842CMH

Erasure of program memory is achieved by removing the COP842CMH from its socket and exposing the transparent window to an ultra-violet light source.

The erasure characteristics of the COP842CMH are such that erasure begins to occur when exposed to light with wavelengths shorter than approximately 4000Å (Angstroms). It should be noted that sunlight and certain types of fluorescent lamps have wavelengths in the 3000Å–4000Å range.

After programming, opaque labels should be placed over the COP842CMH's window to prevent temporary functional failure due to the generation of photo currents or high HALT mode current.

The recommended erasure procedure for the COP842CMH is exposure to short wave ultraviolet light which has a wavelength of 2537Å. The integrated dose (i.e., UV intensity X exposure time) for erasure should be a minimum of 30W-sec/cm^2.

The COP842CMH should be placed within 1 inch of the lamp tubes during erasure. Some lamps have a filter on their tubes which should be removed before erasure. Table IV shows the minimum COP842CMH erasure time for various light intensities.

An erasure system should be calibrated periodically. The distance from lamp to unit should be maintained at one inch. The erasure time increases as the square of the distance. Lamps lose intensity as they age. When a lamp has aged, the system should be checked to make certain that full erasure is occurring.

TABLE IV. Minimum COP842CMH Erasure Time

Light Intensity (Micro-Watts/cm^2)	Erasure Time (Minutes)
15,000	40
10,000	50
5,000	100

Development Support

Development Tools Selection Table

Microcontroller	Order Part Number	Description	Includes	Manual Number
COP822C/842C	MOLE-BRAIN	Brain Board	Brain Board Users Manual	420408188-001
	MOLE-COP8-PB1A	Personality Board	COP880 Personality Board Users Manual	420410806-001
	MOLE-COP8-IBM	Assembler Software for IBM	COP800 Software Users Manual and Software Disk PC-DOS Communications Software Users Manual	424410527-001 420040416-001
	420411060-001	Programmer's Manual		420411060-001

DIAL-A-HELPER

Dial-A-Helper is a service provided by the Microcontroller Applications group. The Dial-A-Helper is an Electronic Bulletin Board Information system and additionally, provides the capability of remotely accessing the development system at a customer site.

INFORMATION SYSTEM

The Dial-A-Helper system provides access to an automated information storage and retrieval system that may be accessed over standard dial-up telephone lines 24 hours a day. The system capabilities include a MESSAGE SECTION (electronic mail) for communications to and from the Microcontroller Applications Group and a FILE SECTION which consists of several file areas where valuable application software and utilities could be found. The minimum requirement for accessing the Dial-A-Helper is a Hayes compatible modem.

If the user has a PC with a communications package then files from the FILE SECTION can be down loaded to disk for later use.

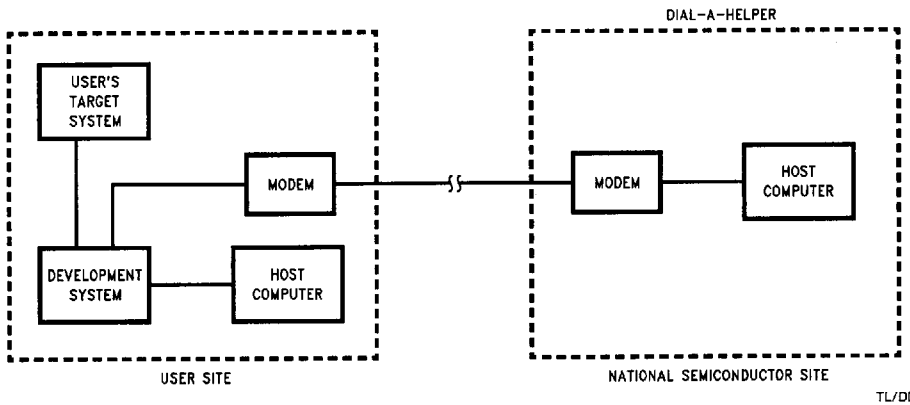
ORDER P/N: MOLE-DIAL-A-HLP

Information System Package contains:
- Dial-A-Helper Users Manual
- Public Domain Communications Software

FACTORY APPLICATIONS SUPPORT

Dial-A-Helper also provides immediate factor applications support. If a user is having difficulty in operating the development system, he can leave messages on our electronic bulletin board, which we will respond to, or under extraordinary circumstances he can arrange for us to actually take control of his system via modem for debugging purposes.

Voice: (408) 721-5582
Modem: (408) 739-1162
Baud: 300 or 1200 Baud
Set-up: Length: 8-Bit
Parity: None
Stop Bit: 1
Operation: 24 Hrs., 7 Days



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