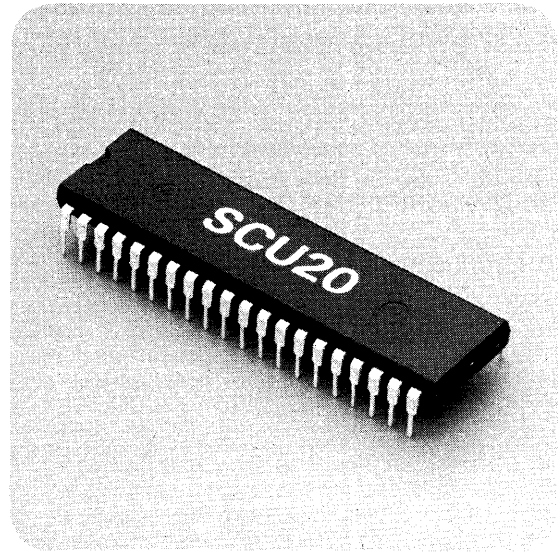


3870 MICROCOMPUTER COMPONENTS

Serial Control Unit SCU20

FEATURES

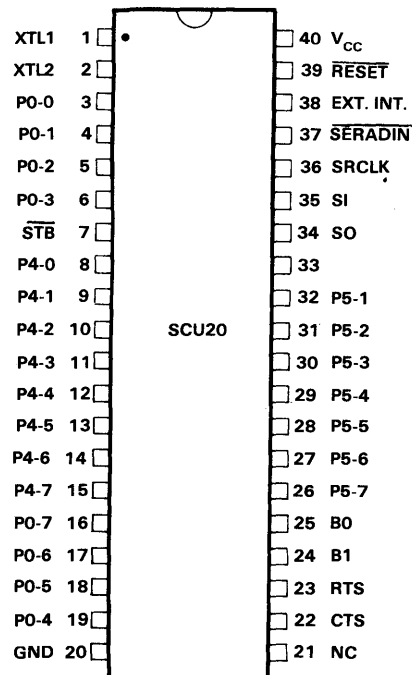
- Provides programmable remote I/O functions, real time operational capabilities, and standardized network communications on a 40 pin chip.
- Performs preprogrammed functions on command, including:
 - Byte input and output
 - Bit input and output
 - Set, clear, and toggle selected pins
 - Data access from real time functions
- Performs real time preprogrammed functions, including:
 - Data log on external interrupt, timer, or host control, up to 63 bytes of data
 - Five Event Counters driven from external interrupt, timer or host control
- Up to 24 programmable I/O pins
- Allows user to network up to 254 SCUs on a single communications channel
- Asynchronous serial data transmission
- Selectable baud rate (300, 1200, 2400, or 9600 Baud)
- Secure, Error resistant data link protocol
- Requires single +5 volt supply
- Low power (275mW typ)



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SCU20 PINOUT

Figure 1



INTRODUCTION

The SCU20 serial control unit is a preprogrammed MK3873 single chip microcomputer. It is a general purpose remote control/data acquisition unit, with 38 preprogrammed functions available to the user.

Communications with the SCU20 takes place over an asynchronous half duplex communications channel at 300, 1200, 2400, or 9600 Baud. The communications protocol is efficient and error resistant, and yet easy to implement on the host system.

The SCU20 can be used for both monitoring and control systems where remote intelligence is required. It can be configured to provide many different input/output and data acquisition functions through its 24 I/O pins. Such intelligent functions as Data Log and Event Counters allow many different applications that will not burden the host system with constant update requirements.

FUNCTIONAL PIN DISCRPTION

The SCU20 is housed in a plastic 40 pin dual in-line package.

Figure 1 shows the location of each pin on the SCU20. The following describes the function of each pin.

SCU20 PINOUT DEFINITION

- XTL1, XTL2 - Time base inputs for 3.6864 MHz crystal.
- P0-0 - P0-7 - SCU port 0. SCU address input or general purpose data port (see SCU Address section).
- \overline{STB} - Data available strobe for port 4.
- P4-0 - P4-7 - SCU port 4. General purpose data port.
- P5-0 - P5-7 - SCU port 5. General purpose data port.
- SRCLK - Clock signal generated by internal Baud rate generator.

- SI - Serial input. Receives serial asynchronous data from the host.
- SO - Serial output. Transmits serial asynchronous data to the host.
- RTS - Request to send.
- CTS - Clear to send.
- \overline{RESET} - External reset.
- EXT. INT. - External interrupt.
- $\overline{SERADIN}$ - Serial address input/address mode (see SCU Address section).
- B0, B1 - Baud rate select.
- V_{CC} - Power supply, 5 volts.
- GND - Power supply ground.

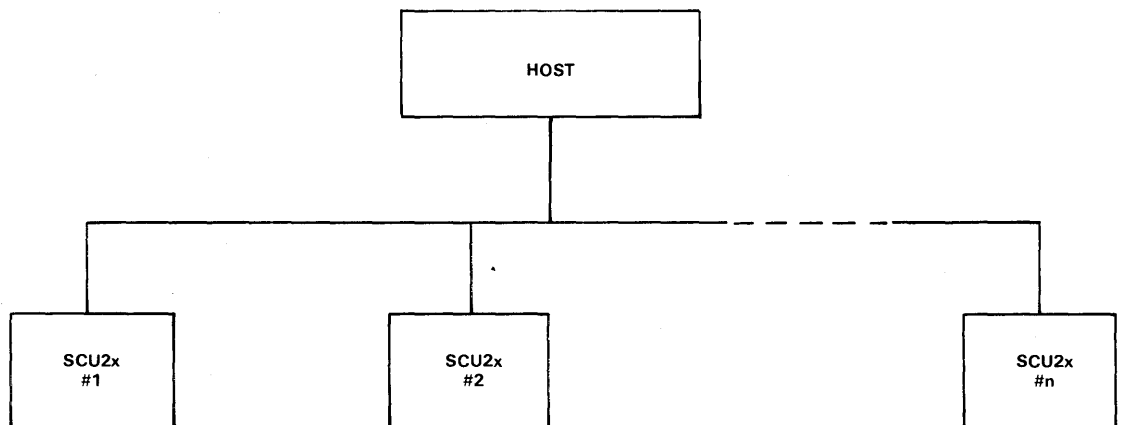
SCU2 NETWORK

The SCU2 Network is a serial linked network of devices in the SCU2 family. All communications are via a common serial link using the SCU2 family communications protocol. In this way, a distributed control facility may be easily implemented from standard parts, and controlled by the host computer via the serial link.

Figure 2 illustrates the SCU2 Network.

SCU2 NETWORK

Figure 2



Each SCU2x in the network has an individual address to which it will respond. All SCU2x devices in the network are slave processors to the host, and are unable to initiate communications except in response to the host.

The operation of the SCU2 network proceeds along the following lines.

When the system is initialized, all SCU2x devices are in the listen mode, and are performing no functions. The host will issue an enquiry command to each of the SCUs, each of which will respond. Once all SCUs have been queried, the host will issue commands to each SCU to set up the particular operational parameters required of it. When this has been done, the host may then use the SCUs to control equipment, measure values, etc., by issuing commands and receiving responses.

Unless issuing a response, the SCU2x is always in the listen mode. If a command has been sent to an SCU2x, a response is expected within a specific time period. If none is forthcoming, it means that the command transmitted was not successfully accumulated by the SCU. In this case, the host must take steps to either notify the operator or to retransmit the command to the SCU.

If a system error occurs in the host, it may suspend

operation of the entire network by outputting the network reset command which causes all SCUs to be reset. This is the only command that does not require a specific SCU address as part of the command. It uses the system reset address which is recognized by each SCU.

SCU ADDRESS

The address to which the SCU responds may be established in one of two ways.

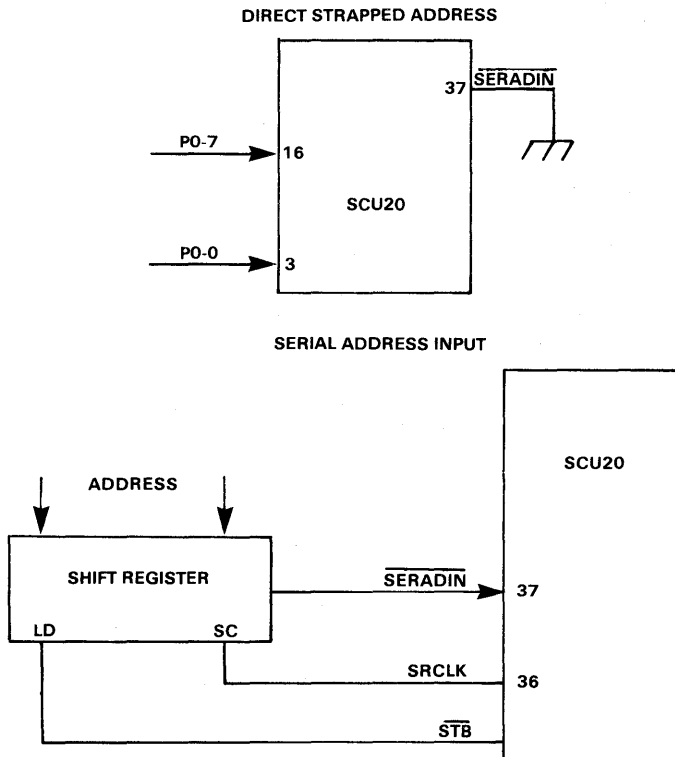
The first mode is the Direct Strapped Address mode, and is enabled by tying the $\overline{\text{SERADIN}}$ pin directly to ground. In this mode, the SCU address is strapped at port 0. Because of this, port 0 is not available as a general purpose I/O port.

The second mode is the Serial Address Input mode. The $\overline{\text{SERADIN}}$ pin is used to input the address as a serial 8-bit stream from a shift register. SRCLK is used as a shift clock for this operation. The $\overline{\text{STB}}$ signal is used at initialization time to cause the address to be loaded into the shift register before shifting begins. In the Serial Address mode, port 0 becomes available for use as a general purpose data I/O port.

Figure 3 illustrates both methods of establishing the SCU address.

SCU20 ADDRESS ESTABLISHMENT

Figure 3



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SCU COMMUNICATIONS

The SCU20 communicates with the host computer over a half duplex asynchronous serial link. The communications protocol is simple, yet error resistant.

The general form of the communication message is as follows:



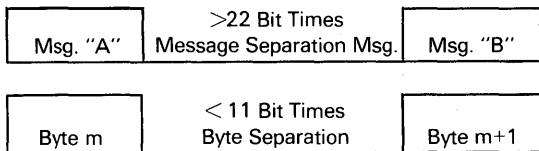
HDR - Message header. Hex '01' indicates a command message from the host; Hex '02' indicates a response from the SCU.

ADDR - SCU Address. Indicates which SCU the message is for, or originates from.

CMD - Command. Indicates the function to be performed.

DATA - Any data that may be required by the particular command.

LRC - Linear Redundancy Check.



Messages are to be transmitted in block mode, with a message separation of at least 22 bit times. Interbyte separations should be no more than 11 bit times.

A message from the host to the SCU will generate a response if there is no transmission error. If any transmission error is detected, no response will be made.

Possible transmission errors are LRC errors, parity errors, interbyte separation errors, or intermessage separation errors.

BAUD RATE SELECTION

The serial Baud rate is selected by a strapped option on the SCU. Those options are listed below:

BAUD RATE	B0 (Pin 25)	B1 (Pin 24)
300	0	0
1200	0	1
2400	1	0
9600	1	1

MODEM SIGNALS

RTS and CTS are provided to facilitate handshaking with modems. Just prior to responding to a valid command, RTS will go to logic 1, indicating that the SCU is ready to send data back to the host. CTS is an input to the SCU that is tested after RTS goes active to determine if the SCU may begin transmitting data.

PARALLEL I/O PORTS

The SCU has a minimum of 2 parallel I/O ports and a maximum of 3 available for general use, depending on the address selection mode chosen. For each of these ports, there exist 2 registers that control and modify the I/O to and from the ports. These are the Data Direction Register (DDR) and the Mask Register(MR).

The Data Direction Register defines the usage of each pin in the port. If a bit is set to 0, then the corresponding pin is used as input. If a bit is set to 1, then the corresponding bit is used as an output. When a port is read, all bits are sampled for input whether or not they are marked for input. When a port is written to, however, only those pins declared as output will be modified.

The Mask Register provides a data mask that may be applied to the input data before transmission to the master. The mask is established once and may be used repeatedly before being changed by establishing a new mask value. If a pin is to be available upon read, the corresponding bit in the mask register is set to 1, while a pin that is to be masked out will have its mask bit set to 0.

SCU PREPROGRAMMED FUNCTIONS

The SCU20 has a variety of preprogrammed functions available to the user. Each of these functions addresses a different general area of application such that the SCU20 is truly a general purpose device.

PORT COMMANDS

There are several commands which allow the host to manipulate the 8-bit general purpose I/O ports. The host may load data into any one or all of the ports, may read any or all of the ports with or without a mask, may read with a new mask, or may read using the last defined mask. When data is loaded, the resulting port state is returned in the response message.

LOGIC COMMANDS

In addition to performing data I/O with the ports, the host may perform logical operations with the ports and data from the host. These commands allow the host to AND, OR, or Exclusive OR (XOR) data with any or all of the ports, and output the result to the ports. The resultant output is returned in the command response message.

BIT COMMANDS

These commands allow the host to SET, CLEAR, TEST, or TOGGLE bits in the ports by specifying bit number (0 - 24). Any pin that is declared as an input will not be changed.

EVENT COUNTERS

There are 5 Event Counters defined in SCU20. They are 16 bit up counters, and are driven by the timer, the external interrupt, or by host command. They may be used as simple event counters, or may be used in conjunction with the Data Log, and Pulse functions.

DATA LOG

The Data Log function allows the user to command the SCU20 to log data from the ports specified in the command, and store the data in the on-board RAM. Up to 63 bytes of data may be accumulated in the log, and may be captured on external interrupt, timer, or host command through use of an Event Counter.

Data from the Log is transmitted back to the host in a single read command burst.

CONTROL COMMANDS

There are several commands to control the SCU20 as well

as the entire SCU2 network. These commands provide the host the ability to query each individual SCU on the network for its type, the last message it sent, and for detailed error codes. In addition, there are commands that allow the host to reset an individual SCU, or to cause the entire SCU network to reset with a single command.

ERROR PROCESSING

The SCU does not provide a "negative acknowledge" response to command stream errors. Those errors are parity errors, LRC errors, unidentifiable commands, overrun, or violation of the separation specifications as described earlier.

In some cases, the SCU will provide error response to functional errors in commands that have been recognized. This response will be either a "NAKO" or a "NAK3" as specified for the command. "NAKO" is the hex value H'FB', and "NAK3" is the hex value H'FE'.

H'2'	ADDR	H'FB'	or	H'FE'	LRC
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SCU COMMANDS

Figure 4 gives a complete list of the commands and functions available to the SCU20.

SCU20 COMMANDS

Figure 4

FUNCTION	COMMAND CODES	# DATA BYTES (CMD)	# DATA BYTES (RESP)	ERR COD RET
** PORT COMMANDS **				
Load Data Direction Registers	1E	3	0	-
Load Port (0, 4, 5)	00,01,02	1	1	-
Load All Ports	03	3	3	-
Read Port (0, 4, 5)	04,05,06	0	1	-
Read All Ports	07	0	3	-
Read Port Masked, Mask Provided	08,09,0A	1	1	-
Read All Ports, Masks Provided	0B	3	3	-
Read Port using Previous Mask	0C,0D,0E	0	1	-
Read All Ports using Previous Masks	0F	0	3	-

III-173 SINGLE CHIP MICROCOMPUTER FAMILY

** PORT LOGIC COMMANDS **				
AND Data to Port	10,11,12	1	1	-
AND Data to All Ports	13	3	3	-
OR Data to Port	14,15,16	1	1	-
OR Data to All Ports	17	3	3	-
XOR Data to Port	18,19,1A	1	1	-
XOR Data to All Ports	1B	3	3	-
** BIT COMMANDS **				
Set Bit in Port	1F	1	0	-
Clear Bit in Port	20	1	0	-
Toggle Bit in Port	21	1	1	-
Test Bit in Port	22	1	1	-
** EVENT COUNTERS **				
Start Event Counter	80	1	0	-
Read Event Counter	81	1	2	NAKO
Clear Event Counter	82	1	0	NAKO
Stop Event Counter	83	1	0	NAKO
Step Event Counter	84	1	0	NAKO
** DATA LOG COMMANDS **				
Start Data Log	85	3	0	NAKO
Stop and Read Data Log	86	0	var.	-
Read Data Log Count	87	0	1	-
** SCU CONTROL COMMANDS **				
Enquiry	1C	0	var.	NAK3
Return SCU Type	1D	0	1	-
Read Error Code	F7	0	1	-
Reset SCU (2 Command Sequence)	F8/F9	0	0	-
General Reset (SCU Network)	FF	0	-	-