

## CMOS Universal Asynchronous Receiver Transmitter (UART)

March 1997

### Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- 8.0MHz Operating Frequency (HD-6402/883B)
- 2.0MHz Operating Frequency (HD-6402/883R)
- Low Power CMOS Design
- Programmable Word Length, Stop Bits and Parity
- Automatic Data Formatting and Status Generation
- Compatible with Industry Standard UARTs
- Single +5V Power Supply
- CMOS/TTL Compatible Inputs

### Description

The HD-6402/883 is a CMOS UART for interfacing computers or microprocessors to an asynchronous serial data channel. The receiver converts serial start, data, parity and stop bits. The transmitter converts parallel data into serial form and automatically adds start, parity and stop bits. The data word length can be 5, 6, 7 or 8 bits. Parity may be odd or even. Parity checking and generation can be inhibited. The stop bits may be one or two or one and one-half when transmitting 5-bit code.

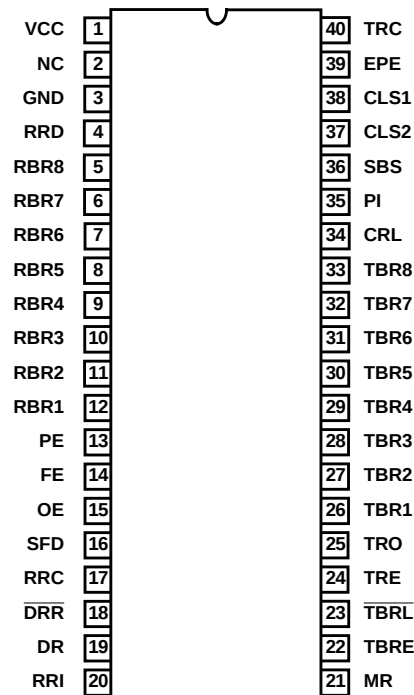
The HD-6402/883 can be used in a wide range of applications including modems, printers, peripherals and remote data acquisition systems. Utilizing the Intersil advanced scaled SAJI IV CMOS process permits operation clock frequencies up to 8.0MHz (500K Baud). Power requirements, by comparison, are reduced from 300mW to 10mW. Status logic increases flexibility and simplifies the user interface.

### Ordering Information

| PACKAGE | TEMPERATURE RANGE | 2MHz = 125K BAUD | 8MHz = 500K BAUD | PKG. NO. |
|---------|-------------------|------------------|------------------|----------|
| CERDIP  | -55°C to +125°C   | HD1-6402R/883    | HD1-6402B/883    | F40.6    |

### Pinout

HD-6402/883 (CERDIP)  
TOP VIEW



# **Control Definition**

| CONTROL WORD |       |    |     |     | CHARACTER FORMAT |           |            |           |
|--------------|-------|----|-----|-----|------------------|-----------|------------|-----------|
| CLS 2        | CLS 1 | PI | EPE | SBS | START BIT        | DATA BITS | PARITY BIT | STOP BITS |
| 0            | 0     | 0  | 0   | 0   | 1                | 5         | ODD        | 1         |
| 0            | 0     | 0  | 0   | 1   | 1                | 5         | ODD        | 1.5       |
| 0            | 0     | 0  | 1   | 0   | 1                | 5         | EVEN       | 1         |
| 0            | 0     | 0  | 1   | 1   | 1                | 5         | EVEN       | 1.5       |
| 0            | 0     | 1  | X   | 0   | 1                | 5         | NONE       | 1         |
| 0            | 0     | 1  | X   | 1   | 1                | 5         | NONE       | 1.5       |
| 0            | 1     | 0  | 0   | 0   | 1                | 6         | ODD        | 1         |
| 0            | 1     | 0  | 0   | 1   | 1                | 6         | ODD        | 2         |
| 0            | 1     | 0  | 1   | 0   | 1                | 6         | EVEN       | 1         |
| 0            | 1     | 0  | 1   | 1   | 1                | 6         | EVEN       | 2         |
| 0            | 1     | 1  | X   | 0   | 1                | 6         | NONE       | 1         |
| 0            | 1     | 1  | x   | 1   | 1                | 6         | NONE       | 2         |
| 1            | 0     | 0  | 0   | 0   | 1                | 7         | ODD        | 1         |
| 1            | 0     | 0  | 0   | 1   | 1                | 7         | ODD        | 2         |
| 1            | 0     | 0  | 1   | 0   | 1                | 7         | EVEN       | 1         |
| 1            | 0     | 0  | 1   | 1   | 1                | 7         | EVEN       | 2         |
| 1            | 0     | 1  | X   | 0   | 1                | 7         | NONE       | 1         |
| 1            | 0     | 1  | x   | 1   | 1                | 7         | NONE       | 2         |
| 1            | 1     | 0  | 0   | 0   | 1                | 8         | ODD        | 1         |
| 1            | 1     | 0  | 0   | 1   | 1                | 8         | ODD        | 2         |
| 1            | 1     | 0  | 1   | 0   | 1                | 8         | EVEN       | 1         |
| 1            | 1     | 0  | 1   | 1   | 1                | 8         | EVEN       | 2         |
| 1            | 1     | 1  | X   | 0   | 1                | 8         | NONE       | 1         |
| 1            | 1     | 1  | x   | 1   | 1                | 8         | NONE       | 2         |

## Absolute Maximum Ratings

Supply Voltage ..... +8.0V  
 Input, Output or I/O Voltage Applied. .... GND -0.5V to  $V_{CC} + 0.5V$   
 Storage Temperature Range ..... -65°C to +150°C  
 Junction Temperature ..... +175°C  
 Lead Temperature (Soldering 10s) ..... +300°C  
 ESD Classification ..... Class 1  
 Typical Derating Factor ..... 1mA/MHz Increase in ICCOP

## Thermal Information

Thermal Resistance .....  $\theta_{JA}$  .....  $\theta_{JC}$   
 CERDIP Package ..... 50°C/W ..... 12°C/W  
 Gate Count ..... 1643 Gates

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

## Operating Conditions

Operating Voltage Range ..... +4.5V to +5.5V    Operating Temperature Range ..... -55°C to +125°C

TABLE 1. HD-6402/883 D.C. ELECTRICAL PERFORMANCE SPECIFICATIONS

Device Guaranteed and 100% Tested

| D.C. PARAMETER             | SYMBOL | CONDITIONS                                      | GROUP A SUBGROUPS | TEMPERATURE                     | LIMITS      |     | UNITS |
|----------------------------|--------|-------------------------------------------------|-------------------|---------------------------------|-------------|-----|-------|
|                            |        |                                                 |                   |                                 | MIN         | MAX |       |
| Logical "1" Input Voltage  | VIH    | VCC = 5.5V                                      | 1, 2, 3           | -55°C ≤ T <sub>A</sub> ≤ +125°C | 2.3         | -   | V     |
| Logical "0" Input Voltage  | VIL    | VCC = 4.5V                                      | 1, 2, 3           | -55°C ≤ T <sub>A</sub> ≤ +125°C | -           | 0.8 | V     |
| Input Leakage Current      | IID    | VIN = GND or VCC,<br>VCC = 5.5V                 | 1, 2, 3           | -55°C ≤ T <sub>A</sub> ≤ +125°C | -1.0        | 1.0 | μA    |
| Logical "1" Output Voltage | VOH    | IOH = -2.5mA,<br>VCC = 4.5V (Note 1)            | 1, 2, 3           | -55°C ≤ T <sub>A</sub> ≤ +125°C | 3.0         | -   | V     |
| Logical "1" Output Voltage | VOH    | IOH = -100μA<br>VCC = 4.5V (Note 1)             | 1, 2, 3           | -55°C ≤ T <sub>A</sub> ≤ +125°C | VCC<br>-0.4 | -   | V     |
| Logical "0" Output Voltage | VOL    | IOL = +2.5mA,<br>VCC = 4.5V (Note 1)            | 1, 2, 3           | -55°C ≤ T <sub>A</sub> ≤ +125°C | -           | 0.4 | V     |
| Output Leakage Current     | IO     | VO = GND or VCC,<br>VCC = 5.5V                  | 1, 2, 3           | -55°C ≤ T <sub>A</sub> ≤ +125°C | -1.0        | 1.0 | μA    |
| Standby Supply Current     | ICCSB  | VIN = GND or VCC;<br>VCC = 5.5V,<br>Output Open | 1, 2, 3           | -55°C ≤ T <sub>A</sub> ≤ +125°C | -           | 100 | μA    |

TABLE 2. HD-6402/883 A.C. ELECTRICAL PERFORMANCE SPECIFICATIONS

Device Guaranteed and 100% Tested

| A.C. PARAMETER                  | SYMBOL     | (NOTE 1) CONDITIONS     | GROUP A SUBGROUPS | TEMPERATURE                     | LIMITS HD-6402/883R |     | LIMITS HD-6402/883B |     | UNITS |
|---------------------------------|------------|-------------------------|-------------------|---------------------------------|---------------------|-----|---------------------|-----|-------|
|                                 |            |                         |                   |                                 | MIN                 | MAX | MIN                 | MAX |       |
| Clock Frequency                 | (1) fCLOCK | VCC = 4.5V<br>CL = 50pF | 9, 10, 11         | -55°C ≤ T <sub>A</sub> ≤ +125°C | -                   | 2.0 | -                   | 8.0 | MHz   |
| Pulse Widths,<br>CRL, DRR, TBRL | (2) tPW    |                         | 9, 10, 11         | -55°C ≤ T <sub>A</sub> ≤ +125°C | 150                 | -   | 75                  | -   | ns    |
| Pulse Width MR                  | (3) tMR    |                         | 9, 10, 11         | -55°C ≤ T <sub>A</sub> ≤ +125°C | 150                 | -   | 150                 | -   | ns    |
| Input Data Setup Time           | (4) tSET   |                         | 9, 10, 11         | -55°C ≤ T <sub>A</sub> ≤ +125°C | 50                  | -   | 20                  | -   | ns    |
| Input Data Hold Time            | (5) tHOLD  |                         | 9, 10, 11         | -55°C ≤ T <sub>A</sub> ≤ +125°C | 60                  | -   | 20                  | -   | ns    |
| Output Enable Time              | (6) tEN    |                         | 9, 10, 11         | -55°C ≤ T <sub>A</sub> ≤ +125°C | -                   | 160 | -                   | 35  | ns    |

NOTE:

- Interchanging of force and sense conditions is permitted.
- Tested with input levels of VIH = 2.76V and VIL = 0.4V. Rise and fall times are driven at 1ns/V.

**TABLE 3. HD-6402/883 ELECTRICAL PERFORMANCE SPECIFICATIONS**

| A.C. PARAMETER           | SYMBOL | CONDITIONS                                                              | NOTES | TEMPERATURE                     | LIMITS |      | UNITS |
|--------------------------|--------|-------------------------------------------------------------------------|-------|---------------------------------|--------|------|-------|
|                          |        |                                                                         |       |                                 | MIN    | MAX  |       |
| Input Capacitance        | CIN    | f = 1Mhz<br>All Measurements are Referenced to Device GND               | 1     | T <sub>A</sub> = +25°C          | -      | 25.0 | pF    |
| Output Capacitance       | CO     |                                                                         | 1     | T <sub>A</sub> = +25°C          | -      | 25.0 | pF    |
| Operating Supply Current | ICCOP  | VCC = 5.5V,<br>Clock Freq. = 2MHz,<br>VIN = VCC or GND,<br>Outputs Open | 1     | -55°C ≤ T <sub>A</sub> ≤ +125°C | -      | 2.0  | mA    |

NOTE:

1. The parameters listed in Table 3 are controlled via design or process parameters and are not directly tested. These parameters are characterized upon initial design and after major process and/or design changes.

**TABLE 4. APPLICABLE SUBGROUPS**

| CONFORMANCE GROUPS | METHOD       | SUBGROUPS                     |
|--------------------|--------------|-------------------------------|
| Initial Test       | 100%/5004    | -                             |
| Interim Test       | 100%/5004    | 1, 7, 9                       |
| PDA                | 100%         | 1                             |
| Final Test         | 100%         | 2, 3, 8A, 8B, 10, 11          |
| Group A            | -            | 1, 2, 3, 7, 8A, 8B, 9, 10, 11 |
| Group C and D      | Samples/5005 | 1, 7, 9                       |



## Die Characteristics

### DIE DIMENSIONS:

126.4 mils x 134.3 mils x 19 mils

### METALLIZATION:

Type: Si-Al

Thickness: 10kÅ - 12kÅ

### GLASSIVATION:

Type: SiO<sub>2</sub>

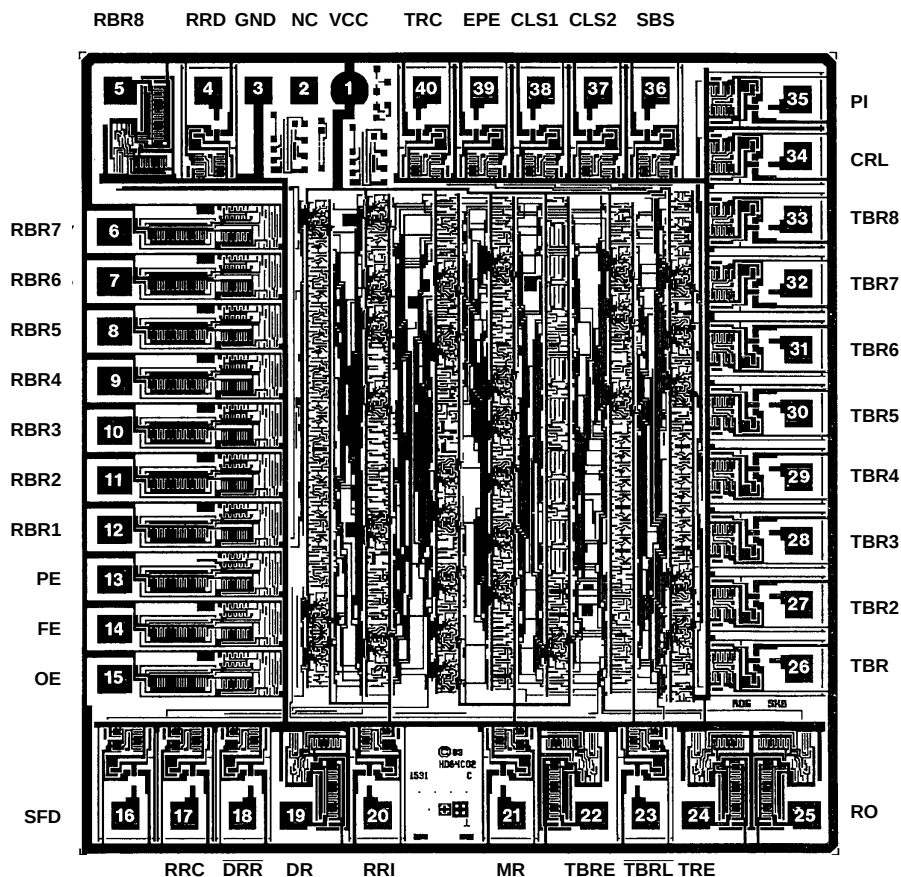
Thickness: 7kÅ - 9kÅ

### WORST CASE CURRENT DENSITY:

$1.42 \times 10^5$  A/cm<sup>2</sup>

## Metallization Mask Layout

HD-6402/883



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