

### DESCRIPTION

The HI-8683 and HI-8684 are system components for interfacing incoming ARINC 429 signals to 8-bit parallel data using proven +5V analog/digital CMOS technology. The HI-8683 is a digital device that requires an external analog line receiver such as the HI-8482 or HI-8588 between the ARINC bus and the device inputs. The HI-8684 incorporates the digital logic and analog line receiver circuitry in a single device.

The HI-8683 is also available as a second source to the DLS-112 with the original 18 pin DIP and 28 pin PLCC package pinouts.

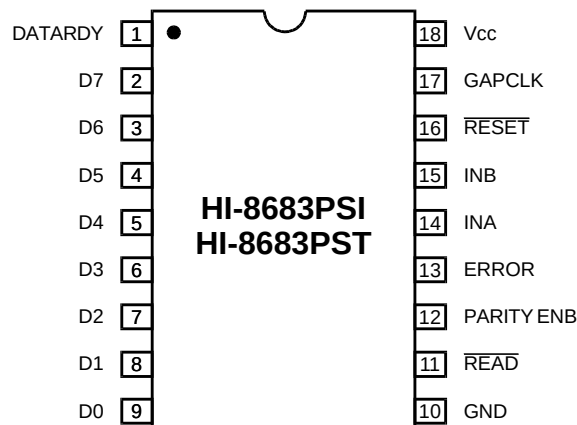
The receivers on the HI-8684 connect directly to the ARINC 429 Bus and translate the incoming signals to normal CMOS levels. Internal comparator levels are set just below the standard 6.5 volt minimum data threshold and just above the standard 2.5 volt maximum null threshold. The -10 version of the HI-8684 allows the incorporation of an external 10K $\Omega$  resistance in series with each ARINC input for lightning protection without affecting ARINC level detection.

Both products offer high speed 8-bit parallel bus interface, a 32-bit buffer, and error detection for word length and parity. A reset pin is also provided for power-on initialization.

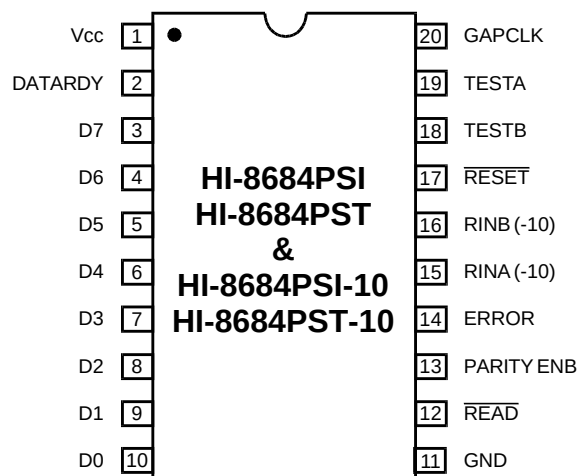
### FEATURES

- Automatic conversion of serial ARINC 429, 575 & 561 data to 8-bit parallel data
- High speed parallel 8-bit data bus
- Error detection - word length and parity
- Reset input for power-on initialization
- On-chip line receiver option (HI-8684)
- Input hysteresis of at least 2 volts (HI-8684)
- Test inputs bypass analog inputs (HI-8684)
- Simplified lightning protection with the ability to add 10 Kohm external series resistors (HI-8684-10)
- Plastic package options - surface mount (SOIC), PLCC and DIP
- Military processing available

### PIN CONFIGURATIONS (Top View)



**HI-8683**  
**18-Pin Plastic SOIC - WB Package**



**HI-8684**  
**20-Pin Plastic SOIC - WB Package**

(See page 8 for additional pin configurations)

## PIN DESCRIPTIONS

| SIGNAL                    | FUNCTION | DESCRIPTION                                                                                                                                                                          |
|---------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DATA RDY                  | OUTPUT   | Receiver data ready flag. A high level indicates data is available in the receive buffer. Flag goes low when the first 8-bit byte is read.                                           |
| D1 to D7                  | OUTPUT   | 8-bit parallel data bus (tri-state)                                                                                                                                                  |
| GND                       | POWER    | 0V                                                                                                                                                                                   |
| $\overline{\text{READ}}$  | INPUT    | Read strobe. A low level transfers receive buffer data to the data bus                                                                                                               |
| PARITY ENB                | INPUT    | Parity Enable - A high level activates odd parity checking which replaces the 32nd ARINC bit with an error bit. Otherwise, the 32nd ARINC bit is unchanged                           |
| ERROR                     | OUTPUT   | Error Flag. A high level indicates a bit count error (number of ARINC bits was less than or greater than 32) and/or a parity error if parity detection was enabled (PARITY ENB high) |
| INA                       | INPUT    | Positive digital serial data input (HI-8683 only)                                                                                                                                    |
| INB                       | INPUT    | Negative digital serial data input (HI-8683 only)                                                                                                                                    |
| RINA/RINA-10              | INPUT    | Positive direct ARINC serial data input (HI-8684 & HI-8684-10 only)                                                                                                                  |
| RINB/RINB-10              | INPUT    | Negative direct ARINC serial data input (HI-8684 & HI-8684-10 only)                                                                                                                  |
| $\overline{\text{RESET}}$ | INPUT    | Internal logic states are initialized with a low level                                                                                                                               |
| TESTA                     | INPUT    | Used in conjunction with the TESTB input to bypass the built-in analog line receiver circuitry (HI-8684 & HI-8684-10 only)                                                           |
| TESTB                     | INPUT    | Used in conjunction with the TESTA input to bypass the built-in analog line receiver circuitry (HI-8684 & HI-8684-10 only)                                                           |
| GAPCLK                    | INPUT    | Gap Clock. Determines the minimum time required between ARINC words for detection. The minimum word gap time is between 16 and 17 clock cycles of this signal.                       |
| Vcc                       | POWER    | +5V $\pm 10\%$ supply                                                                                                                                                                |

## FUNCTIONAL DESCRIPTION

The HI-8683 and HI-8684 are serial to 8-bit parallel converters. The incoming data stream is serially shifted into an input register, checked for errors, and then transferred in parallel to a 32-bit receive buffer. The receive data can be accessed using four 8-bit parallel read operations while the next serial data stream is being received.

### RECEIVER INPUTS

Figure 1 is a block diagram of both the HI-8683 and HI-8684. The difference between the two products is the HI-8684 has a built-in line receiver whereas the HI-8683 is strictly a digital device and requires an external ARINC line receiver such as the Holt HI-8482, HI-8588 or HI-8590 to interface to the ARINC 429 bus.

### HI-8684 Line Receiver

Typically 35K $\Omega$  resistors are in series with both the RINA and RINB ARINC 429 inputs. They connect to level translators whose resistance to GND is typically 10K $\Omega$ . After level translation, the buffered inputs drive a differential amplifier. The differential signal is compared to levels derived from a divider between VCC and GND. The nominal settings correspond to a One/Zero amplitude of 6.0V and a Null amplitude of 3.3V. A valid ARINC One/Zero input sets a latch and a Null input resets the latch.

Since any added external series resistance will affect the voltage translation, the HI-8684-10 is available with 25K $\Omega$  of the 35K $\Omega$  series resistance required for proper ARINC 429 level detection. The remaining 10K $\Omega$  required that must be added can be incorporated in other external circuitry such as lightning protection. Except for the different input series resistance, the HI-8684 and HI-8684-10 are identical.

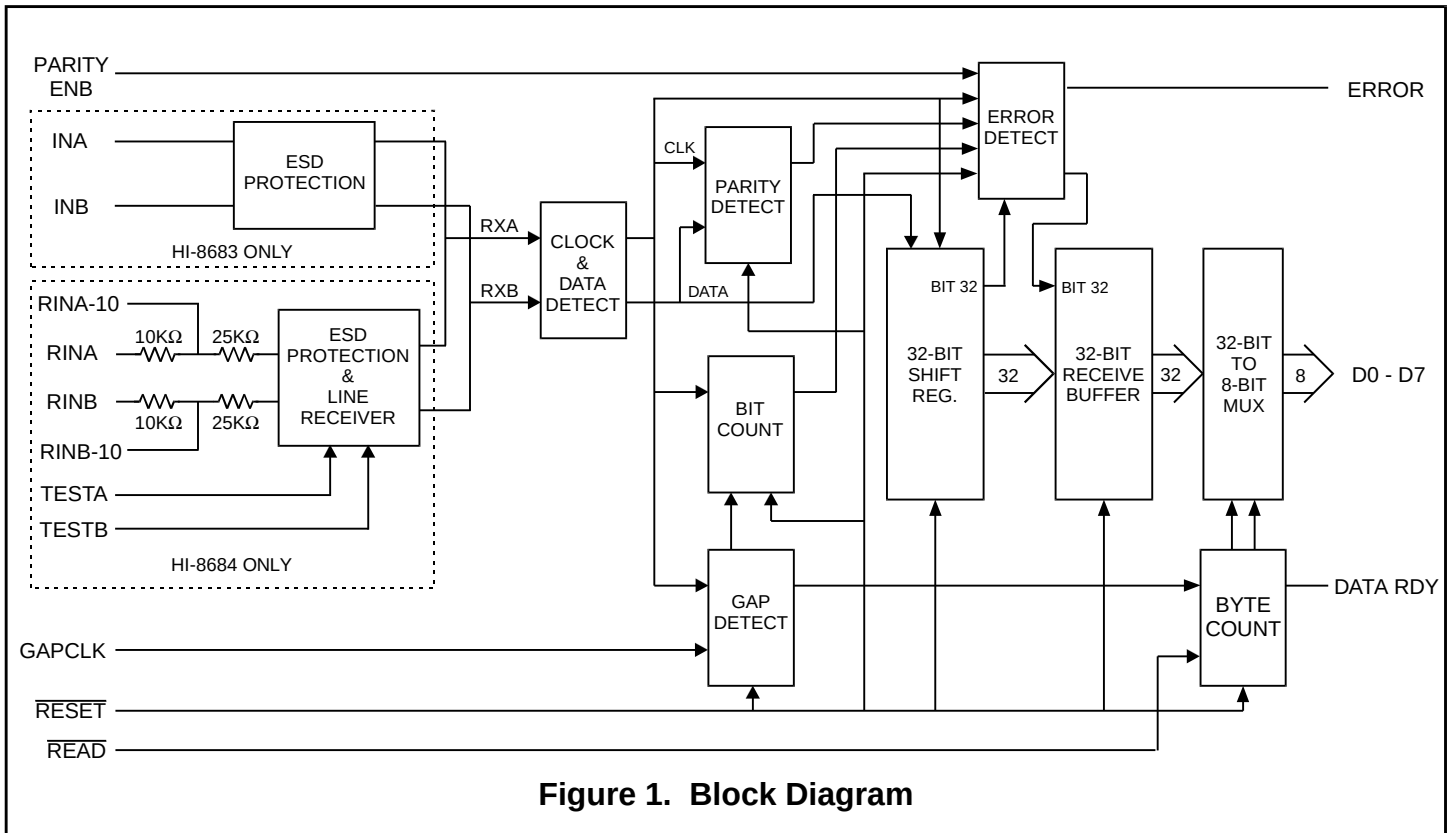


Figure 1. Block Diagram

## FUNCTIONAL DESCRIPTION (cont.)

### PROTOCOL DETECTION

ARINC clock and data in the HI-8683 are derived from the two streams of digital data at the INA and INB inputs and the resulting One/Zero data is shifted into a 32-bit input register as illustrated in Figure 3.

In the HI-8684, the One/Zero data shifted into the input register is created from either the two digital outputs of the built-in line receiver (Figure 3) or the TESTA and TESTB inputs (Figure 4).

For ARINC 561 operation, the INA and INB data streams inputs must be derived from the ARINC 561 data, clock and sync with external logic.

### GAP DETECTION

The end of a data word is detected by an internal counter that times out when a data One or Zero is not received for a period equal to 16 cycles of the GAPCLK signal. The gap detection time may vary between 16 and 17 cycles of the GAPCLK signal since the incoming data and GAPCLK are not usually synchronous inputs. The required frequency of GAPCLK is a function of the minimum gap time specified for the type of ARINC data being received. Table 1 indicates typical frequencies that may be used for the various data rates normally encountered.

| DATABUS TYPE | BIT PERIOD (μs) | MINIMUM GAP (μs) | GAP CLOCK MHz      | GAP DETECTION TIME (μs)               |
|--------------|-----------------|------------------|--------------------|---------------------------------------|
| 429          | 10              | 45               | 0.75<br>1.0<br>1.5 | 21.3 - 22.7<br>16 - 17<br>10.7 - 11.3 |
| 429          | 69 - 133        | 310 - 599        | 0.1                | 160 - 170                             |
| 575          | 69 - 133        | 310 - 599        | 0.1                | 160 - 170                             |
| 561          | 69 - 133        | 103 - 200        | 0.2                | 80 - 85                               |

Table 1 - Typical Gap Detection Times

## FUNCTIONAL DESCRIPTION (cont.)

### ERROR CHECKING

Once a word gap is detected, the data word in the input register is transferred to the receive buffer and checked for errors.

When parity detection is enabled (PARITY ENB high), the received word is checked for odd parity. If there is a parity error, the 32nd bit of the received data word is set high.

If parity checking is disabled (PARITY ENB low) the 32nd bit of the data word is always the 32nd ARINC bit received.

The ERROR flag output is set high upon receipt of a word gap and the number of bits received since the previous word gap is less than or greater than 32. The ERROR flag is reset low when the next valid ARINC word is written into the receive buffer or when RESET is pulsed low.

### READING RECEIVE BUFFER

When the data word is transferred to the receive buffer, the DATA RDY pin goes high. The data word can then be read in four 8-bit bytes by pulsing the READ input low as indicated in Figure 5. The first read cycle resets DATA RDY low and increments an internal counter to the next 8-bit byte. The counter continues to increment on each read cycle until all four bytes are read. The relationship between each bit of an ARINC word received and each bit of the four 8-bit data bus bytes is specified in Figure 2.

When a new ARINC word is received it always overwrites the receive buffer. If the first byte of the previous word has not been read, then previous data is lost and the receive buffer will contain the new ARINC word. However, if the DATA RDY pin goes high between the reading of the first and fourth bytes, the previous read bytes are no longer valid because the unread bytes have been overwritten by the new ARINC word. Also, the next read will be of the first byte of the new ARINC word since the internal byte counter is always reset to the first byte when new data is transferred to the receive buffer.

| Read | Byte   | Data Bus Bits | ARINC Bits          |
|------|--------|---------------|---------------------|
| 1st  | Byte 1 | D0 - D7       | ARINC 1 - ARINC 8   |
| 2nd  | Byte 2 | D0 - D7       | ARINC 9 - ARINC 16  |
| 3rd  | Byte 3 | D0 - D7       | ARINC 17 - ARINC 24 |
| 4th  | Byte 4 | D0 - D7       | ARINC 25 - ARINC 32 |

FIGURE 2. ORDER OF RECEIVED DATA

### RESET

A low on the RESET input sets a flip-flop which initializes the internal logic. When RESET goes high, the internal logic remains in the initialized state until the first word gap is detected preventing reception of a partial word.

### TEST MODE (HI-8684 only)

The built-in differential line receiver on the HI-8684 can be disabled allowing the data and clock detection circuitry to be driven directly with digital signals. The logical OR function of the TESTA and TESTB is defined in Truth Table 1. The two inputs can be used for testing the receiver logic and for inputting ARINC 429 type data derived from another source/ protocol. See Figure 4 for typical test input timing.

The device should always be initialized with RESET immediately after entering the test mode to clear a partial word that may have been received since the last word gap. Otherwise, an ERROR condition may occur and the first 32 bits of data on the test inputs may not be properly received.

Also, when entering the test mode, both TESTA and TESTB should be set high and held in that state for at least one word gap period (17 gap clocks) after RESET goes high.

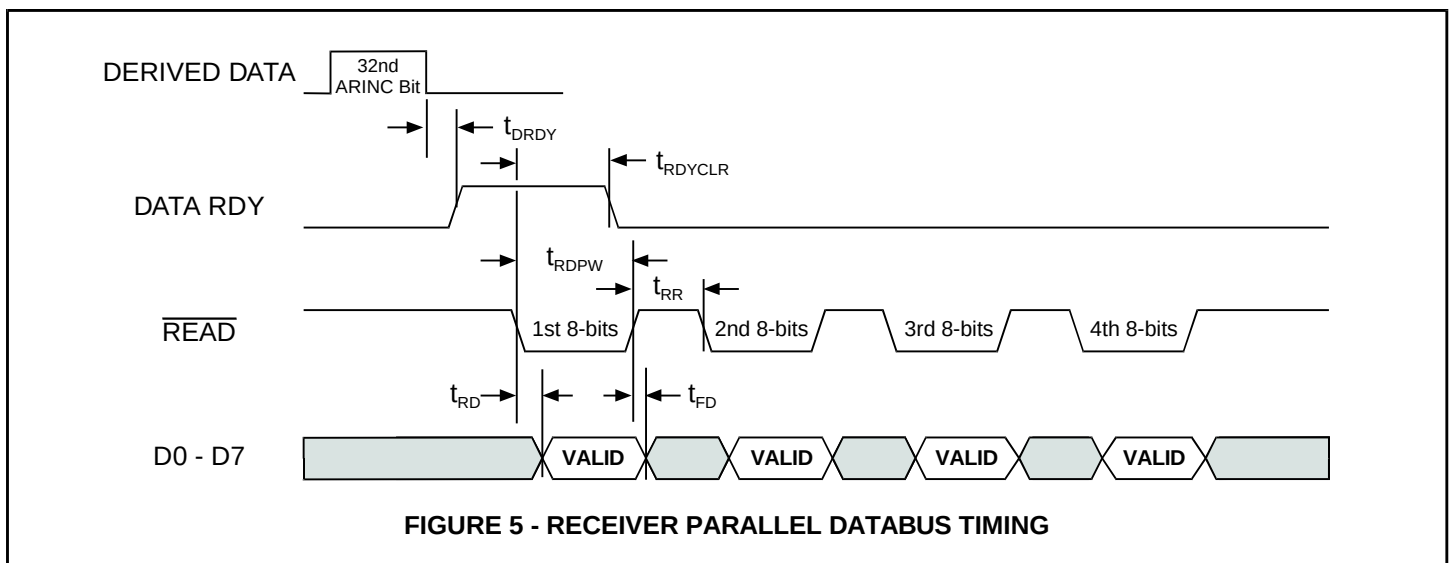
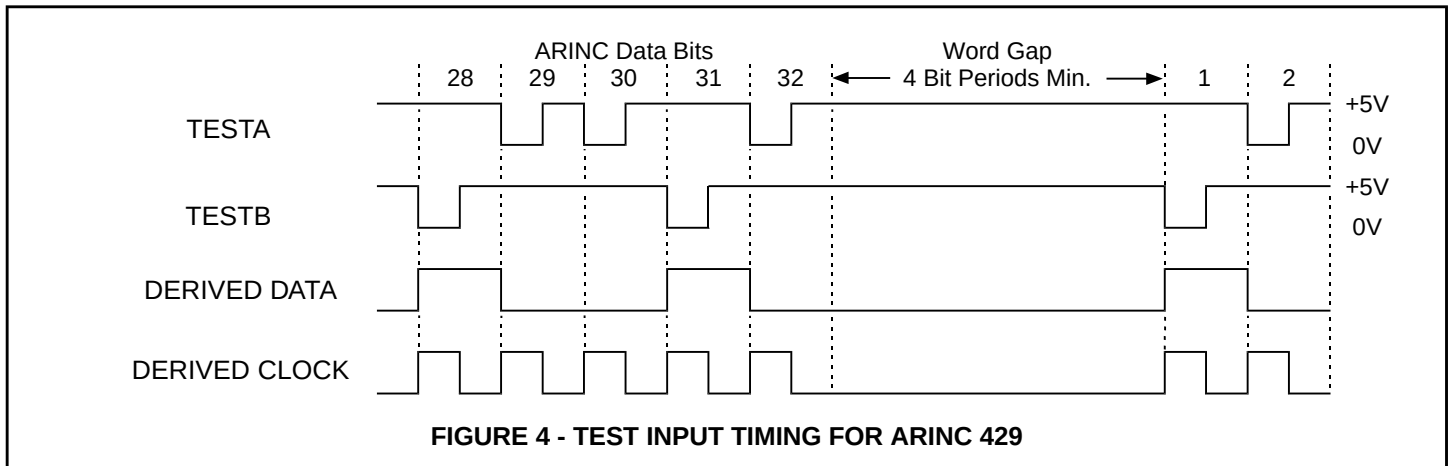
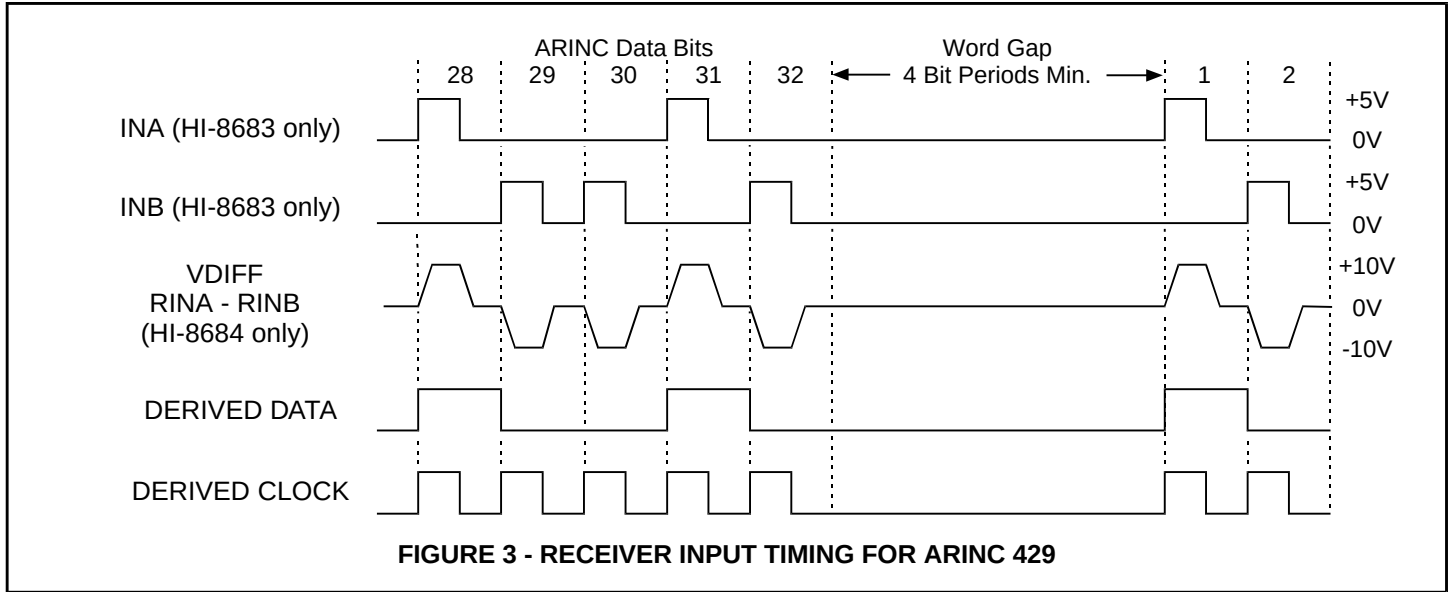
When exiting the test mode, both test inputs should be held low and the device initialized with RESET.

TRUTH TABLE 1.

| RINA             | RINB             | TESTA | TESTB | RXA | RXB |
|------------------|------------------|-------|-------|-----|-----|
| -1.50 to +1.50V  | -1.50V to +1.50V | 0     | 0     | 0   | 0   |
| -3.25V to -6.50V | +3.25V to +6.50V | 0     | 0     | 0   | 1   |
| +3.25V to +6.50V | -3.25V to -6.50V | 0     | 0     | 1   | 0   |
| X                | X                | 0     | 1     | 0   | 1   |
| X                | X                | 1     | 0     | 1   | 0   |
| X                | X                | 1     | 1     | 0   | 0   |

X = don't care

## TIMING DIAGRAMS



## ABSOLUTE MAXIMUM RATINGS

All voltages referenced to GND

|                                                     |                              |
|-----------------------------------------------------|------------------------------|
| Supply voltages<br>V <sub>CC</sub> .....            | +7.0V                        |
| Voltage on inputs<br>RINA (-10) to RINB (-10) ..... | +29V to - 29V                |
| All other input pins.....                           | -0.3 to V <sub>CC</sub> +0.3 |
| DC current per input pin .....                      | +10mA                        |
| Power dissipation at 25°C<br>plastic 18-pin SO..... | 1.9W, derate 15.4mW/°C       |
| plastic 18-pin DIP.....                             | 1.6W, derate 13.3mW/°C       |
| plastic 20-pin SO.....                              | 1.4W, derate 11.5mW/°C       |
| plastic 20-pin PLCC .....                           | 2.0W, derate 17.2mW/°C       |
| Solder Temperature<br>Leads .....                   | +280°C for 10 sec            |
| Package body .....                                  | +220°C                       |
| Storage Temperature .....                           | -65°C to +150°C              |

## RECOMMENDED OPERATING CONDITIONS

|                                                 |                 |
|-------------------------------------------------|-----------------|
| Supply Voltages<br>V <sub>CC</sub> .....        | +5V ± 10%       |
| Temperature Range<br>Industrial Screening ..... | -40°C to +85°C  |
| Hi-Temp Screening .....                         | -55°C to +125°C |
| Military Screening.....                         | -55°C to +125°C |
| Junction Temperature, T <sub>j</sub> .....      | ≤+175°C         |

*NOTE: Stresses above absolute maximum ratings or outside recommended operating conditions may cause permanent damage to the device. These are stress ratings only. Operation at the limits is not recommended.*

## DC ELECTRICAL CHARACTERISTICS

V<sub>CC</sub> = 5V, GND = 0V, T<sub>A</sub> = Operating Temperature Range (unless otherwise specified).

| PARAMETERS                                                                                         | SYMBOL                                                   | TEST CONDITIONS                                        | MIN           | TYP            | MAX                 | UNITS                   |
|----------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|---------------|----------------|---------------------|-------------------------|
| <b>ARINC Bus Inputs</b> (RINA & RINB, HI-8684 only)                                                |                                                          |                                                        |               |                |                     |                         |
| Differential input voltage<br>one or zero<br>null<br>common mode                                   | V <sub>DIN</sub><br>V <sub>NIN</sub><br>V <sub>COM</sub> | differential voltage<br>" " " "<br>with respect to GND | 6.5<br>-<br>- | 10.0<br>-<br>- | 13.0<br>2.75<br>5.0 | volts<br>volts<br>volts |
| Input resistance<br>RINA (-10) to RINB (-10)<br>RINA (-10) or RINB (-10) to GND or V <sub>CC</sub> | R <sub>DIFF</sub><br>R <sub>SUP</sub>                    | supplies floating<br>" " " "                           | 30<br>19      | 75<br>40       | -<br>-              | Kohm<br>Kohm            |
| Input capacitance (Guaranteed but not tested)<br>differential<br>to GND<br>to V <sub>CC</sub>      | C <sub>DIFF</sub><br>C <sub>G</sub><br>C <sub>H</sub>    | RINA to RINB                                           | -<br>-<br>-   | -<br>-<br>-    | 20<br>20<br>20      | pF<br>pF<br>pF          |

## DC ELECTRICAL CHARACTERISTICS (cont.)

V<sub>CC</sub> = 5V, GND = 0V, TA = Operating Temperature Range (unless otherwise specified).

| PARAMETERS                                                                                                                 | SYMBOL                             | TEST CONDITIONS                                       | MIN        | TYP    | MAX                    | UNITS          |
|----------------------------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------------------------|------------|--------|------------------------|----------------|
| <b>Digital Inputs</b> (INA, INB, $\overline{\text{RESET}}$ , GAPCLK, $\overline{\text{READ}}$ , PARITY ENA, TESTA & TESTB) |                                    |                                                       |            |        |                        |                |
| Input voltage<br>high<br>low                                                                                               | V <sub>IH</sub><br>V <sub>IL</sub> |                                                       | 2.0<br>0.0 | -<br>- | V <sub>CC</sub><br>0.8 | volts<br>volts |
| Input current<br>source<br>sink                                                                                            | I <sub>IH</sub><br>I <sub>IL</sub> | V <sub>IN</sub> = 5.0V<br>V <sub>IN</sub> = 0.0V      | -<br>-1.0  | -<br>- | 1.0<br>-               | μA<br>μA       |
| Input capacitance                                                                                                          | C <sub>I</sub>                     |                                                       | -          | -      | 8.0                    | pF             |
| <b>Outputs</b> (D0 to D7, ERROR & DATA RDY)                                                                                |                                    |                                                       |            |        |                        |                |
| Output voltage<br>high<br>low                                                                                              | V <sub>OH</sub><br>V <sub>OL</sub> | I <sub>OH</sub> = -1.0 mA<br>I <sub>OL</sub> = 1.6 mA | 2.7<br>-   | -<br>- | -<br>0.4               | volts<br>volts |
| Output tri-state current (D0 - D7 only)                                                                                    | I <sub>IH</sub><br>I <sub>IL</sub> | V <sub>OH</sub> = 5.0V<br>V <sub>OL</sub> = 0.0V      | -<br>-1.0  | -<br>- | 1.0<br>-               | μA<br>μA       |
| Output capacitance                                                                                                         | C <sub>O</sub>                     |                                                       | -          | -      | 15                     | pF             |
| <b>Operating Supply Current</b>                                                                                            |                                    |                                                       |            |        |                        |                |
| V <sub>CC</sub> (HI-8683 only)                                                                                             | I <sub>CC1</sub>                   | V <sub>IN</sub> = 0.0V, outputs open                  | -          | -      | 0.2                    | mA             |
| V <sub>CC</sub> (HI-8684 only)                                                                                             | I <sub>CC2</sub>                   | V <sub>IN</sub> = 0.0V, outputs open                  | -          | -      | 6.5                    | mA             |

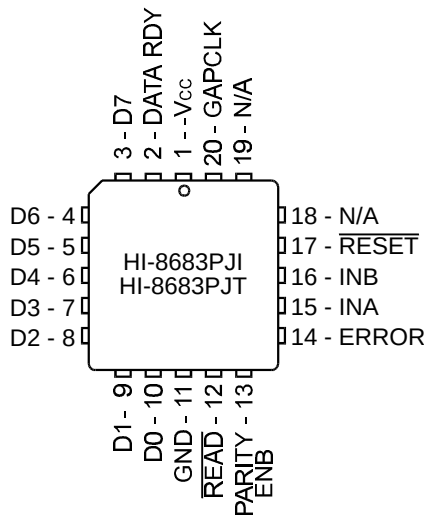
## AC ELECTRICAL CHARACTERISTICS

V<sub>CC</sub> = 5V, GND = 0V, TA = Operating Temperature Range (unless otherwise specified).

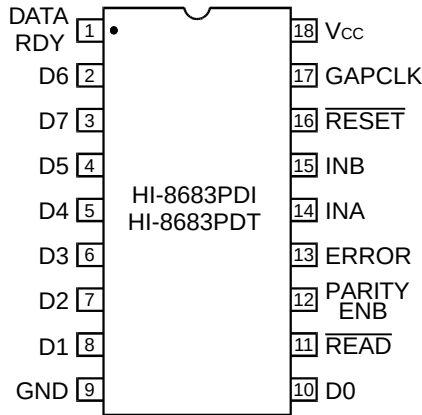
| PARAMETERS                                                            | SYMBOL              | TEST CONDITIONS | MIN | TYP | MAX | UNITS  |
|-----------------------------------------------------------------------|---------------------|-----------------|-----|-----|-----|--------|
| $\overline{\text{READ}}$ pulse width                                  | t <sub>RDPW</sub>   |                 | 50  |     |     | ns     |
| Data delay from $\overline{\text{READ}}$                              | t <sub>RD</sub>     |                 |     |     | 20  | ns     |
| $\overline{\text{READ}}$ to data floating                             | t <sub>FD</sub>     |                 |     |     | 20  | ns     |
| $\overline{\text{READ}}$ to DATA RDY clear                            | t <sub>RDYCLR</sub> |                 |     |     | 25  | ns     |
| $\overline{\text{READ}}$ pulse to next $\overline{\text{READ}}$ pulse | t <sub>RR</sub>     |                 | 25  |     |     | ns     |
| GAPCLK frequency                                                      | f <sub>GC</sub>     |                 |     | 1   |     | MHz    |
| 32 ARINC bit to DATA RDY                                              | t <sub>DRDY</sub>   |                 | 16  |     | 17  | clocks |

## HI-8683 & HI-8684 PIN CONFIGURATIONS

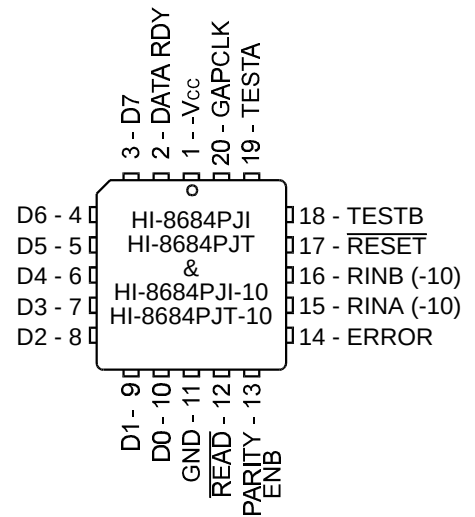
(See page 1 for additional pin configurations)



**HI-8683**  
20-Pin Plastic PLCC



**HI-8683**  
18-Pin Plastic DIP



**HI-8684**  
20-Pin Plastic PLCC

## ORDERING INFORMATION

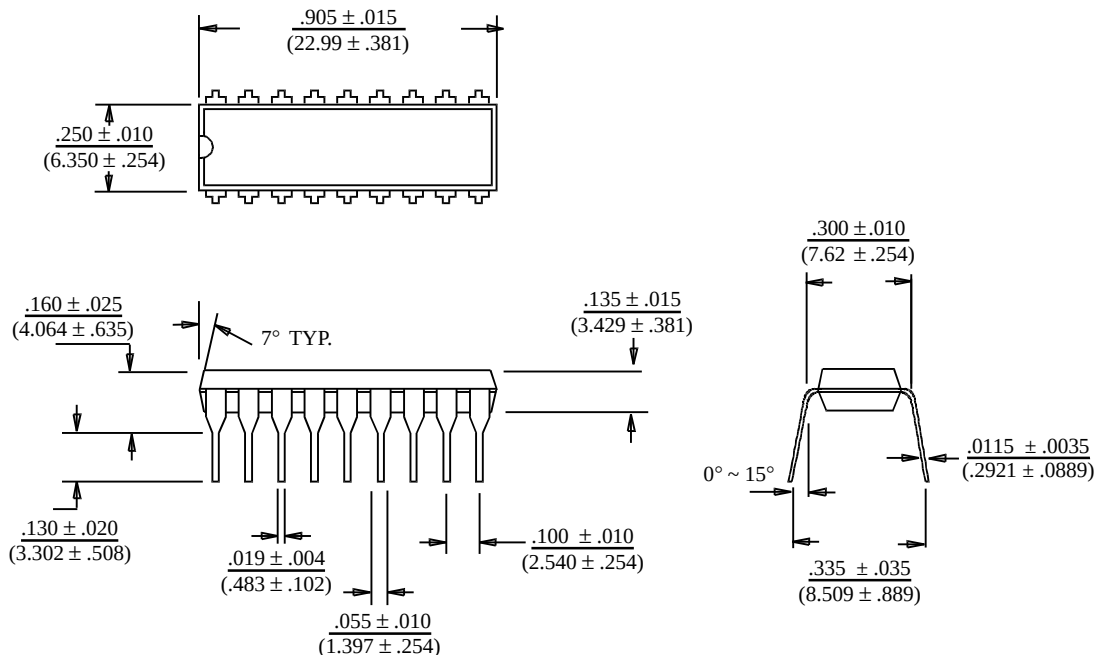
| PART NUMBER   | PACKAGE DESCRIPTION      | BUILT-IN LINE RECVR | 10KΩ RES. REQUIRED | TEMPERATURE RANGE | FLOW | BURN IN | LEAD FINISH |
|---------------|--------------------------|---------------------|--------------------|-------------------|------|---------|-------------|
| HI-8683PDI    | 18 PIN PLASTIC DIP       | NO                  | NO                 | -40°C TO +85°C    | I    | NO      | SOLDER      |
| HI-8683PDT    | 18 PIN PLASTIC DIP       | NO                  | NO                 | -55°C TO +125°C   | T    | NO      | SOLDER      |
| HI-8683PJI    | 20 PIN PLASTIC PLCC      | NO                  | NO                 | -40°C TO +85°C    | I    | NO      | SOLDER      |
| HI-8683PJT    | 20 PIN PLASTIC PLCC      | NO                  | NO                 | -55°C TO +125°C   | T    | NO      | SOLDER      |
| HI-8683PSI    | 18 PIN PLASTIC SOIC - WB | NO                  | NO                 | -40°C TO +85°C    | I    | NO      | SOLDER      |
| HI-8683PST    | 18 PIN PLASTIC SOIC - WB | NO                  | NO                 | -55°C TO +125°C   | T    | NO      | SOLDER      |
| HI-8684PJI    | 20 PIN PLASTIC PLCC      | YES                 | NO                 | -40°C TO +85°C    | I    | NO      | SOLDER      |
| HI-8684PJT    | 20 PIN PLASTIC PLCC      | YES                 | NO                 | -55°C TO +125°C   | T    | NO      | SOLDER      |
| HI-8684PSI    | 20 PIN PLASTIC SOIC - WB | YES                 | NO                 | -40°C TO +85°C    | I    | NO      | SOLDER      |
| HI-8684PST    | 20 PIN PLASTIC SOIC - WB | YES                 | NO                 | -55°C TO +125°C   | T    | NO      | SOLDER      |
| HI-8684PJI-10 | 20 PIN PLASTIC PLCC      | YES                 | YES                | -40°C TO +85°C    | I    | NO      | SOLDER      |
| HI-8684PJT-10 | 20 PIN PLASTIC PLCC      | YES                 | YES                | -55°C TO +125°C   | T    | NO      | SOLDER      |
| HI-8684PSI-10 | 20 PIN PLASTIC SOIC - WB | YES                 | YES                | -40°C TO +85°C    | I    | NO      | SOLDER      |
| HI-8684PST-10 | 20 PIN PLASTIC SOIC - WB | YES                 | YES                | -55°C TO +125°C   | T    | NO      | SOLDER      |

Legend: WB - Wide Body



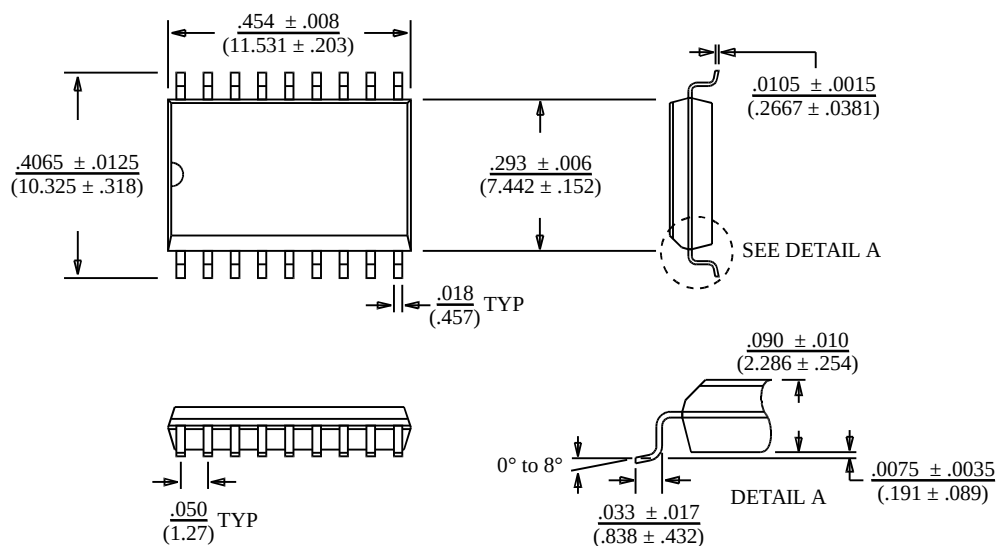
### 18-PIN PLASTIC DIP

Package Type: 18P



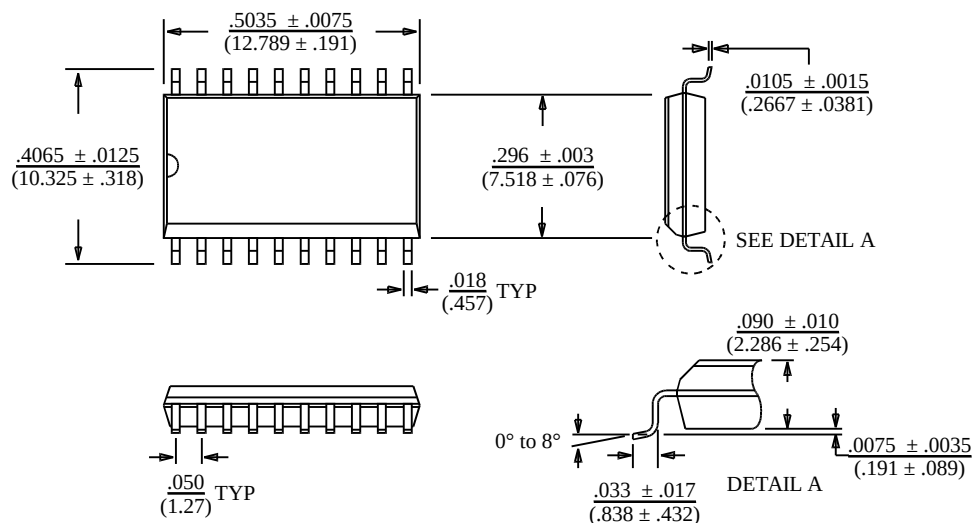
### 18-PIN PLASTIC SMALL OUTLINE (SOIC) - WB (Wide Body)

Package Type: 18HW



### 20-PIN PLASTIC SMALL OUTLINE (SOIC) - WB (Wide Body)

Package Type: 20HW



### 20-PIN PLASTIC PLCC

Package Type: 20J

