HARRIS SEMICONDUCTOR HIN230 thru HIN241

ADVANCE INFORMATION

December 1993

+5V Powered RS-232 Transmitters/Receivers

Features

- Meets All RS-232C and V.28 Specifications
- Requires Only Single +5V Power Supply
  - (+5V and +12V - HIN231 and HIN239)
- Onboard Voltage Doubler/Inverter
- Low Power Consumption
- Low Power Shutdown Function
- Tri-State TTL/CMOS Receiver Outputs
- Multiple Drivers
  - ±10V Output Swing for +5V Input
  - 300Ω Power-Off Source Impedance
  - Output Current Limiting
  - TTL/CMOS Compatible
  - 30V/μs Maximum Slew Rate
- Multiple Receivers
  - ±30V Input Voltage Range
  - 3kΩ to 7kΩ Input Impedance
  - 0.5V Hysteresis to Improve Noise Rejection

Description

The HIN230-HIN241 family of RS-232 transmitters/receivers interface circuits meet all EIA RS-232C and V.28 specifications, and are particularly suited for those applications where ±12V is not available. They require a single +5V power supply (except HIN231 and HIN239) and features onboard charge pump voltage converters which generate +10V and -10V supplies from the 5V supply. The family of devices offer a wide variety of RS232 transmitter/receiver combinations to accommodate various applications (see Selection Table).

The drivers feature true TTL/CMOS input compatibility, slew-rate-limited output, and 300Ω power-off source impedance. The receivers can handle up to +30V, and have a 3kΩ to 7kΩ input impedance. The receivers also feature hysteresis to greatly improve noise rejection.

Applications

- Any System Requiring RS-232 Communications Port
  - Computer - Portable, Mainframe, Laptops
  - Peripheral - Printers and Terminals
  - Portable Instrumentation
  - Modems

Selection Table

PART NUMBER	POWER SUPPLY VOLTAGE	NUMBER OF RS-232 DRIVERS	NUMBER OF RS-232 RECEIVERS	EXTERNAL COMPONENTS	LOW POWER SHUTDOWN /TTL TRI-STATE	NO. OF LEADS
HIN230	+5V	5	0	4 Capacitors	YES/NO	20
HIN231	+5V and +7.5V to 13.2V	2	2	2 Capacitors	NO/NO	16
HIN232	+5V	2	2	4 Capacitors	NO/NO	16
HIN234	+5V	4	0	4 Capacitors	NO/NO	16
HIN236	+5V	4	3	4 Capacitors	YES/YES	24
HIN237	+5V	5	3	4 Capacitors	NO/NO	24
HIN238	5V	4	4	4 Capacitors	NO/NO	24
HIN239	+5V and +7.5V to 13.2V	3	5	2 Capacitors	NO/YES	24
HIN240	+5V	5	5	4 Capacitors	YES/YES	44
HIN241	+5V	4	5	4 Capacitors	YES/YES	28

Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HIN230CB	0°C to +70°C	20 Lead SOIC
HIN230IB	-40°C to +85°C	20 Lead SOIC
HIN230BY		Die
HIN231CB	0°C to +70°C	16 Lead SOIC (W)
HIN231IB	-40°C to +85°C	16 Lead SOIC (W)
HIN231BY		Die
HIN232CP	0°C to +70°C	16 Lead Plastic DIP
HIN232CB	0°C to +70°C	16 Lead SOIC (W)
HIN232IP	-40°C to +85°C	16 Lead Plastic DIP
HIN232IJ	-40°C to +85°C	16 Lead Ceramic DIP
HIN232IB	-40°C to +85°C	16 Lead SOIC (W)
HIN232MJ	-55°C to +125°C	16 Lead Ceramic DIP
HIN232BY		Die
HIN234CB	0°C to +70°C	16 Lead SOIC (W)
HIN234IB	-40°C to +85°C	16 Lead SOIC (W)
HIN234BY		Die
HIN236CP	0°C to +70°C	24 Lead Plastic DIP
HIN236CB	0°C to +70°C	24 Lead SOIC
HIN236IP	-40°C to +85°C	24 Lead Plastic DIP
HIN236IB	-40°C to +85°C	24 Lead SOIC
HIN236BY		Die

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HIN237CP	0°C to +70°C	24 Lead Plastic DIP
HIN237CB	0°C to +70°C	24 Lead SOIC
HIN237IP	-40°C to +85°C	24 Lead Plastic DIP
HIN237IB	-40°C to +85°C	24 Lead SOIC
HIN237BY		Die
HIN238CP	0°C to +70°C	24 Lead Plastic DIP
HIN238CB	0°C to +70°C	24 Lead SOIC
HIN238IP	-40°C to +85°C	24 Lead Plastic DIP
HIN238IB	-40°C to +85°C	24 Lead SOIC
HIN238BY		Die
HIN239CP	0°C to +70°C	24 Lead Plastic DIP
HIN239CB	0°C to +70°C	24 Lead SOIC
HIN239IP	-40°C to +85°C	24 Lead Plastic DIP
HIN239IB	-40°C to +85°C	24 Lead SOIC
HIN239BY		Die
HIN240CN	0°C to +70°C	44 Lead MQFP
HIN240IN	-40°C to +85°C	44 Lead MQFP
HIN241CB	0°C to +70°C	28 Lead SOIC
HIN241IB	-40°C to +85°C	28 Lead SOIC
HIN241CA	0°C to +70°C	28 Lead SSOP
HIN241IA	-40°C to +85°C	28 Lead SSOP

Pin Description

PIN	FUNCTION
V_{CC}	Power Supply Input 5V ±10%
V+	Internally generated positive supply (+10V nominal), HIN231 and HIN239 requires +7.5V to +13.2V.
V-	Internally generated negative supply (-10V nominal).
GND	Ground lead. Connect to 0V.
C+	External capacitor (+ terminal) is connected to this lead.
C-	External capacitor (- terminal) is connected to this lead.
C2+	External capacitor (+ terminal) is connected to this lead.
C2-	External capacitor (- terminal) is connected to this lead.
T_{IN}	Transmitter Inputs. These leads accept TTL/CMOS levels. An internal 400KΩ pull-up resistor to V_{CC} is connected to each lead.
T_{OUT}	Transmitter Outputs. These are RS-232 levels (nominally ±10V).
R_{IN}	Receiver Inputs. These inputs accept RS-232 input levels. An internal 5KΩ pull-down resistor to GND is connected to each input.
R_{OUT}	Receiver Outputs. These are TTL/CMOS levels.
$\overline{EN}$	Enable input. This is an active low input which enables the receiver outputs. With EN = 5V, the outputs are placed in a high impedance state.
SD	Shutdown Input. With SD = 5V, the charge pump is disabled, the receiver outputs are in a high impedance state and the transmitters are shut off.
NC	No Connect. No connections are made to these leads.

Absolute Maximum Ratings

V_{CC} to Ground ..... (GND -0.3V) <V_{CC} < 6V
V+ to Ground ..... (V_{CC} -0.3V) <V+ < 12V
V- to Ground ..... -12V < V- < (GND +0.3V)
Input Voltages
$T1_{IN}$, $T2_{IN}$ ..... (V- -0.3V) < V_{IN} < (V+ +0.3V)
$R1_{IN}$, $R2_{IN}$ ..... ±30V
Output Voltages
$T1_{OUT}$, $T2_{OUT}$ ..... (V- -0.3V) < V_{TXOUT} < (V+ +0.3V)
$R1_{OUT}$, $R2_{OUT}$T ..... (GND -0.3V) < V_{RXOUT} < (V+ +0.3V)
Short Circuit Duration
$T1_{OUT}$, $T2_{OUT}$ ..... Continuous
$R1_{OUT}$, $R2_{OUT}$ ..... Continuous

Thermal Information

Continuous Total Power Dissipation (T_A = +25°C)

Package	θ_{JA}	θ_{JC}
Plastic DIP 16 Lead	100°C/W	-
Plastic DIP 24 Lead	75°C/W	-
Plastic SOIC 16 Lead (W)	100°C/W	-
Plastic SOIC 24 Lead	85°C/W	-
Plastic SOIC 28 Lead	80°C/W	-
Plastic SSOP 28 Lead	100°C/W	-
Plastic MQFP 44 Lead	80°C/W	-
16 Lead CERDIP	80°C/W	24°C/W

Storage Temperature Range ..... -65°C to +150°C
Lead Temperature (Soldering 10s) ..... +300°C
Operating Temperature Range
HIN-XXXCX ..... 0°C to +70°C
HIN-XXXIX ..... -40°C to +85°C

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.

Electrical Specifications

Test Conditions: V_{CC} = +5V ±10%, T_A = Operating Temperature Range

PARAMETER	TEST CONDITIONS	LIMITS			UNITS
		MIN	TYP	MAX	
Output Voltage Swing, T_{OUT}	Transmitter Outputs, 3kΩ to Ground	±5	±9	±10	V
Power Supply Current, I_{CC}	No Load, T_A = +25°C, HIN232-233	-	5	10	mA
	HIN230, HIN234-238, HIN240-241	-	7	15	mA
	HIN231, HIN239	-	0.4	1	mA
Shutdown Supply Current, I_{CC}(SD)			1	10	µA
Input Logic Low, T_{IN}, $\overline{EN}$, V_{IL}	T_{IN}, $\overline{EN}$, Shutdown	-	-	0.8	V
Input Logic High, V_{IH}	T_{IN}	2.0	-	-	V
	$\overline{EN}$, Shutdown	2.4	-	-	V
Logic Pullup Current, I_P	$T1_{IN}$, $T2_{IN}$ = 0V	-	15	200	µA
RS-232 Input Voltage Range, V_{IN}		-30	-	+30	V
Receiver Input Impedance, R_{IN}	V_{IN} = ±3V	3.0	5.0	7.0	kΩ
Receiver Input Low Threshold, V_{IN} (H-L)	V_{CC} = 5.0V, T_A = +25°C	0.8	1.2	-	V
Receiver Input High Threshold, V_{IN} (L-H)	V_{CC} = 5.0V, T_A = +25°C	-	1.7	2.4	V
Receiver Input Hysteresis, V_{HYST}		0.2	0.5	1.0	V
TTL/CMOS Receiver Output Voltage Low, V_{OL}	I_{OUT} = 1.6mA H/N (231-232 I_{OUT} = 3.2mA)	-	0.1	0.4	V
TTL/CMOS Receiver Output voltage High, V_{OH}	I_{OUT} = -1.0mA	3.5	4.6	-	V
Output Enable Time, t_{EN}	HIN236, 239, 240, 241		400		ns
Output Disable Time, t_{DIS}	HIN236, 239, 240, 241		250		ns
Propagation Delay, t_{PD}	RS-232 to TTL	-	0.5	-	µs
Instantaneous Slew Rate, SR	C_L = 10pF, R_L = 3kΩ, T_A = +25°C (Note 1)	-	-	30	V/µs
Transition Region Slew Rate, SR_T	R_L = 3kΩ, C_L = 2500pF Measured from +3V to -3V or -3V to +3V	-	3	-	V/µs
Output Resistance, R_{OUT}	V_{CC} = V+ = V- = 0V, V_{OUT} = ±2V	300	-	-	Ω
RS-232 Output Short Circuit Current, I_{SC}	$T1_{OUT}$ or $T2_{OUT}$ shorted to GND	-	±10	-	mA

NOTE: 1. Guaranteed by design.

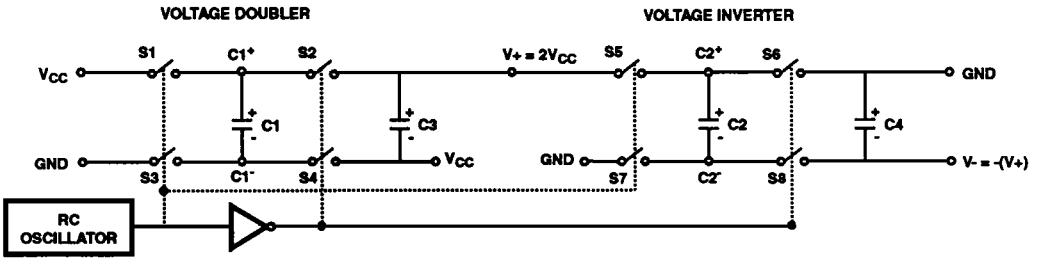

FIGURE 1. CHARGE PUMP

Detailed Description

The HIN230 thru HIN241 family of RS-232 transmitters/receivers are powered by a single +5V power supply (except HIN-231 and HIN239), feature low power consumption, and meet all EIA RS232C and V.28 specifications. The circuit is divided into three sections: the charge pump, transmitter, and receiver.

Charge Pump

An equivalent circuit of the charge pump is illustrated in Figure 1. The charge pump contains two sections: the voltage doubler and the voltage inverter. Each section is driven by a two phase, internally generated clock to generate +10V and -10V. The nominal clock frequency is 16kHz. During phase one of the clock, capacitor C1 is charged to V_{CC}. During phase two, the voltage on C1 is added to V_{CC}, producing a signal across C3 equal to twice V_{CC}. At the same time, C2 is also charged to $2V_{CC}$, and then during phase one, it is inverted with respect to ground to produce a signal across C4 equal to $-2V_{CC}$. The charge pump accepts input voltages up to 5.5V. The output impedance of the voltage doubler section (V+) is approximately 200Ω, and the output impedance of the voltage inverter section (V-) is approximately 450Ω. A typical application uses 1µF capacitors for C1-C4, however, the value is not critical. Increasing the values of C1 and C2 will lower the ouput impedance of the voltage doubler and inverter, increasing the values of the reservoir capacitors, C3 and C4, lowers the ripple on the V+ and V- supplies.

During shutdown mode (HIN230, 235, 236, 240 and 241), SHUTDOWN control line set to logic "1", the charge pump is turned off, V+ is pulled down to V_{CC}, V- is pulled up to GND, and the supply current is reduced to less than 10µA. The transmitter outputs are disabled and the receiver outputs are placed in the high impedance state.

Transmitters

The transmitters are TTL/CMOS compatible inverters which translate the inputs to RS-232 outputs. The input logic threshold is about 26% of V_{CC}, or 1.3V for V_{CC} = 5V. A logic 1 at the input results in a voltage of between -5V and V- at the output, and a logic 0 results in a voltage between +5V and (V+ -0.6V). Each transmitter input has an internal 400kΩ pullup resistor so any unused input can be left unconnected and its output remains in its low state. The output voltage swing meets the RS-232C specifications of ±5V minimum with the worst case conditions of: all transmitters driving 3kΩ minimum load impedance, V_{CC} = 4.5V, and maximum allowable operating temperature. The transmitters have an internally limited output slew rate which is less than 30V/µs. The outputs are short circuit protected and can be shorted to ground indefinitely. The powered down output impedance is a minimum of 300Ω with ±2V applied to the outputs and V_{CC} = 0V.

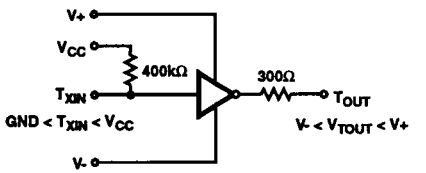

FIGURE 2. TRANSMITTER

Receivers

The receiver inputs accept up to ±30V while presenting the required 3kΩ to 7kΩ input impedance even it the power is off (V_{CC} = 0V). The receivers have a typical input threshold of 1.3V which is within the ±3V limits, known as the transition region, of the RS-232 specifications. The receiver output is 0V to V_{CC}. The output will be low whenever the input is greater than 2.4V and high whenever the input is floating or driven between +0.8V and -30V. The receivers feature 0.5V hysteresis to improve noise rejection. The receiver Enable line $\overline{EN}$, when set to logic "1", (HIN235, 236, 239, 240, and 241) disables the receiver outputs, placing them in the high impedance mode. The receiver outputs are also placed in the high impedance state when in shutdown mode.

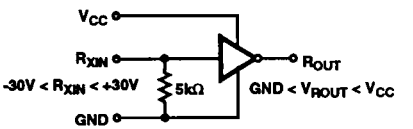

FIGURE 3. RECEIVER