HX422R

Honeywell

Quad RS422 Differential Line Receiver Radiation Hardened 3.3V SOI CMOS

Features

- Four Independent Receivers
- Rad Hard: >300k Rad(Si) Total Dose
- Single +3.3 V Analog Supply
- Common Receiver Enable Control
- Tristate Outputs
- Temperature Range: -55°C to 125°C
- Generally Compatible to TIA/EIA-422-B
- Built in Hysteresis
- 10mA Output Drive
- Maximum Data Rate: 20Mb/s

Mixed Signal Rad Hard Process

The HX422R is fabricated on space qualified SOI CMOS process. High-speed precision analog circuits are now combined with high-density logic circuits that can reliably withstand the harshest environments.

Low Power

The HX422R dissipates less than 200mW with all outputs toggling at 10MHz data rate.

Common Receiver Enable Control (EN, EN*)

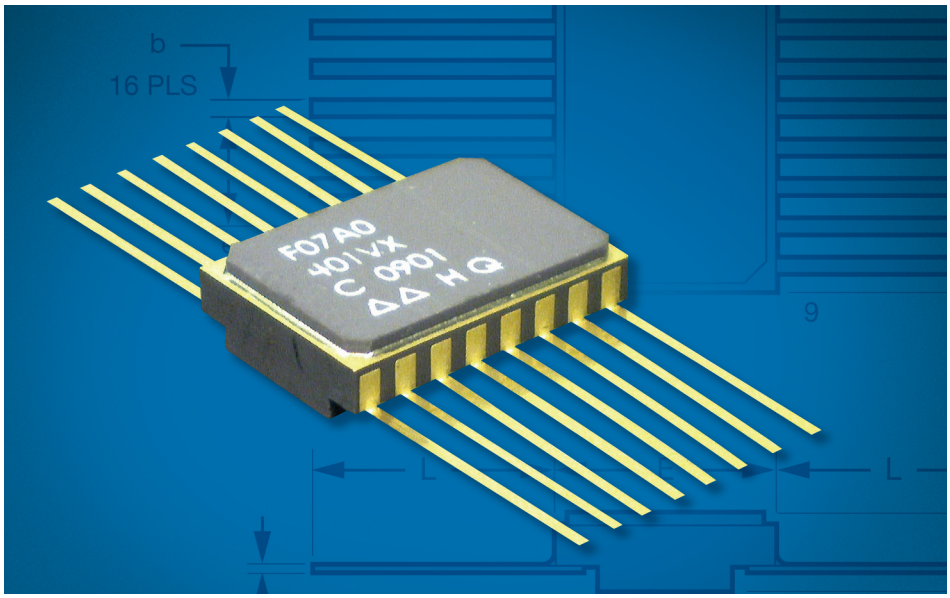
The EN and EN* inputs allow the user to put the digital outputs into high impedance three-state mode.

Dual Power Supply Capability

The HX422R uses a single +3.3V power supply simplifying system power supply design.

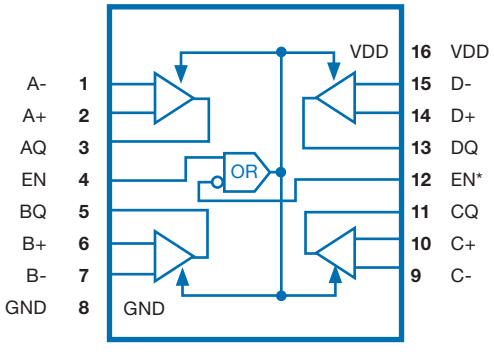
Space Qualified Package

The HX422R is packaged in a 16 lead ceramic flat pack.



The HX422R is a radiation hardened Silicon On Insulator (SOI) CMOS quad differential line receiver designed to meet the standard RS422 requirements and digital data transmission over balanced lines. It features four independent receivers with a common receiver enable control and high impedance outputs. The HX422R has a maximum operating frequency of 20Mb/s. The circuit has built in hysteresis to improve noise margin and output stability for slow changing input signals.

Package Pinout



Truth Table

EN	EN*	$V_{IN(DIFF)}$	Q
L	H	X	Z
H	X	<-200 mV	L
X	L	<-200 mV	L
H	X	>+200 mV	H
X	L	>+200 mV	H

Signal Definition

Signal	Description
A+, A- B+, B-	Differential Data Input signals
C+, C- D+, D-	Differential Data Input signals
AQ, BQ, CQ, DQ	Output signals, CMOS levels
EN, EN*	Output Enable Control pins. The combination of EN = L and EN* = H will put the outputs into the high impedance state. All other combinations of EN and EN* will allow data through the drivers.

Recommended Operating Conditions

Parameter	Symbol	Conditions	Limits Min	Limits Max	Units
Supply Voltage	V_{DD}		3.0	3.6	V
Input Voltage A+/-, B+/-, C+/-, D+/-	VIN(Diff)		-7	7	V
Input Voltage (E+, E-)	VIN(Enable)		0	VDD	V
Input Common Mode Range A+/-, B+/-, C+/-,D+/-	VCM		-6	+6	V
Differential Input Voltage	VDIFF		-5	+5	V
High Level Input Voltage (E+, E-)	VIH	VDD = 3.0 V to 3.6 V	0.7VDD		V
Low Level Input Voltage (E+, E-)	VIL	VDD = 3.0 V to 3.6 V		0.3VDD	V
Output Voltage	VO		-0.3	VDD + 0.3	V
Case Operating Temperature	T_C		-55	+125	°C

Absolute Maximum Ratings (1)(2)

Parameter	Symbol	Conditions	Limits Min	Limits Max	Units
Supply Voltage	V_{DD}	—	-0.5	+6.5	V
DC Input Voltage (EN, EN*)	V_{IN}		-0.5	VDD + 0.5	
Common Mode Range	V_{CM}	—	-7	+7	V
Input Voltage A+/-, B+/-, C+/-, D+/-	$Vin_{(DIFF)}$	—	-8	+8	V
Differential Input Voltage	V_{DIFF}		-6.5	+6.5	V
Receiver Output Voltage (AQ, BQ, CQ, DQ)	VO	—	-0.5	V_{DD} +0.5	V
Input Diode Clamp Current	I_{IK}		-180	+180	mA
Output Short Circuit Current	I_{OS}	1 second, 1 output	15	120	mA
Receiver Output Current	IO	—	-20	+20	mA
Storage Temperature	T_{STG}		-65	+150	°C
Thermal Resistance, Junction to Case	θ_{JC}			16.5	°C/W
Junction Temperature	T_J	—	—	+175	°C
Lead Temperature (soldering, 5 seconds)	T_{LMAX}	—	—	+300	°C
ESD (HBM)	—	—	2000	—	V

(1) Stresses above absolute maximum ratings may cause damage to the device.
(2) The input overshoot and undershoot voltage can exceed voltage limits provided that the input and output clamp currents are not exceeded.

Radiation Hardness Ratings

Parameter	Limits	Units	Test Conditions
Total Dose (3)	≥300	krad(Si)	VDD = Maximum
Transient Dose Rate Upset	≥1x10^9	rad(Si)/s	PW = 20ns, 3µs X-ray, VDD = Minimum
Dose Rate Survivability	≥1 x10^{12}	rad(Si)/s	PW = 20ns, 3µs X-ray, VDD = Maximum
Neutron Fluence	≥1 x10^{14}	N/cm^2	1MeV equivalent energy, Unbiased

(1) Ambient temperature 25°C unless otherwise specified.
(2) Device will not latch up due to any of the specified radiation exposure conditions.

Radiation Performance

Total Ionizing Radiation Dose

The device will meet all stated functional and electrical specifications after the specified total ionizing radiation dose. All electrical and timing performance parameters will remain within specifications, post rebound (based on extrapolation), after an operational period of 15 years. Total dose hardness is assured by wafer level testing of process monitor transistors using 10 KeV X-ray. Parameter correlations have been made between 10 KeV X-rays applied at a dose rate of $5x10^5$ rad(SiO_2)/min at T= 25°C and gamma rays (Cobalt 60 source) to ensure that wafer level X-ray testing is consistent with standard military radiation test environments.

Transient Pulse Ionizing Radiation

The HMXMUX01 will meet any functional or electrical specification after exposure to a radiation pulse up to the transient dose rate survivability specification, when applied under recommended operating conditions. Note that the current conducted during the pulse by the MUX inputs, outputs, and power supply may significantly exceed the normal operating levels. The application design must accommodate these effects.

Neutron Radiation

The device will meet any functional or timing specification after exposure to the specified neutron fluence under recommended operating or storage conditions.

Latchup and Snapback

The Analog Multiplexer will not latch up due to any of the above radiation exposure conditions when applied under recommended operating conditions. Fabrication with the SOI substrate material provides oxide isolation between adjacent PMOS and NMOS transistors and eliminates any potential SCR latchup structures. Sufficient transistor body tie connections to the p- and n-channel substrates are made to ensure no source/drain snapback occurs.

ESD (Electrostatic Discharge) Sensitive

The HX422R is ESD rated as Class 2 per ANSI/ESD S20.20. Proper ESD precautions should be taken to avoid degradation or damage to the device.

Electrical Requirements (1)(2)(3)

Parameter	Symbols	Conditions	Limits Min	Limits Max	Units
Supply Current		V_{DD} = 3.6 V, all outputs toggling			mA
	I_{DDOP1}	2Mb/s	—	40	
	I_{DDOP3}	10 Mb/s	—	60	
Differential Line Input Voltage (2)	V_{TH6}	V_{CM} = +6V, VDD=3.0V	-200	200	mV
	V_{TH0}	V_{CM} = 0V, VDD=3.0V	-200	200	
	V_{THM6}	V_{CM} = -6V, VDD=3.0V	-200	200	
Differential Line Input Threshold Hysteresis (2) (4)	V_{HY}	V_{CM} = 0	5	100	mV
Input Resistance (Line pins) (2) (4)	R_{IN6}	V_{CM} = +6V	6k	15k	Ohms
	R_{IN0}	V_{CM} = 0	6k	15k	
	R_{INM6}	V_{CM} = -6V	6k	15k	
Input Current (Line pins) (2)	I_{IH1}	V_{CM} = +6V	—	1000	µA
	I_{IL1}	V_{CM} = -6V	-1300	—	
Input Threshold (E+, E-) (3)	V_{IL}	V_{DD} = 3.0 V	0.9	—	V
Input Threshold (E+, E-) (3)	V_{IH}	V_{DD} = 3.6 V	—	2.52	V
Input Current (Enable) (3)	I_{IH2} I_{IL2}	V_{DD} = 3.6 V, V_{IN} = 3.6V or 0V	-10	10	µA
Output Tristate Current	I_{OZL} I_{OZH}	V_{DD} = 3.6 V, outputs disabled, tester force 0 V (I_{OZ_L}) or 3.6 V (I_{OZ_H}) on output pins	-10	10	µA
Output High Voltage	V_{OH}	I_{OH} = -10 mA, V_{DD} = 3.0V	2.5	—	V
Output Low Voltage	V_{OL}	I_{OL} = 10 mA V_{DD} = 3.0 V	—	0.5	V
Input Capacitance Diff Inputs (2) (4)	C_I			12	pF
Output Capacitance CMOS Outputs (4)	C_O			15	pF

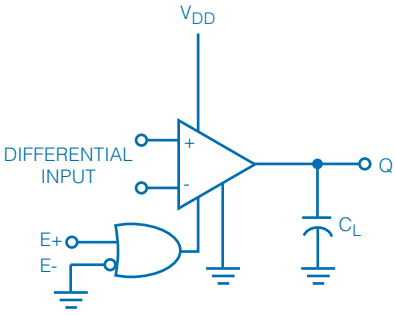
(1) Test conditions shall be as follows: 3.0 V ≤ V_{DD} ≤ 3.6 V, -55°C ≤ T_C ≤ +125°C, V_{SS} = 0 V
(2) Differential inputs refer to A-, A+, B-, B+, C-, C+, D-, D+.
(3) E+, E- are the Enable pins.
(4) Guaranteed but not tested.

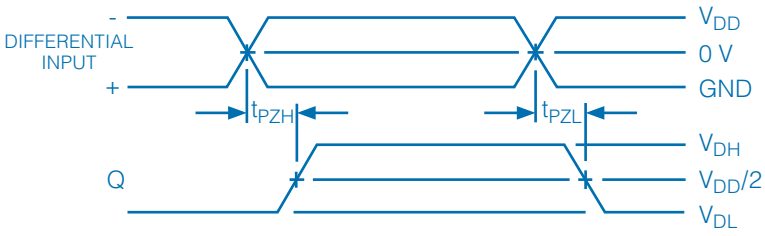
Timing Parameters

Parameter	Symbol	Condition	Limits Min	Limits Max	Units
Differential Propagation Delay High to Low		V_{DD} = 3.0, 3.6 V CL = 15pF			
	T_{PHL1}	VDIFF = 500mV	0	54	nS
	T_{PHL2}	VDIFF = 1000mV	0	45	nS
Differential Propagation Delay Low to High		V_{DD} = 3.0, 3.6 V CL = 15pF			
	T_{PLH1}	VDIFF = 500mV	0	54	nS
	T_{PLH2}	VDIFF = 1000mV	0	45	nS
Disable Time High to Z	T_{PHZ}	V_{DD} = 3.0, 3.6 V CL = 15pF	0	25	nS
Disable Time Low to Z	T_{PLZ}	I_{OH} = -10mA	0	25	nS
Enable Time Z to Low	T_{PZL}	I_{OL} = +10mA	2.5	25	nS
Enable Time to High	T_{PZH}		2.5	25	nS
Maximum Data Rate		V_{DD} = 3.0, 3.6 V			
	F_{DATA1}	VDIFF = 200mV	10		Mb/s
	F_{DATA2}	VDIFF = 1000mV	20		Mb/s
Maximum Operating Frequency		V_{DD} = 3.0, 3.6 V			
	F_{MAX1}	VDIFF = 200mV	5		MHz
	F_{MAX2}	VDIFF = 1000mV	10		MHz

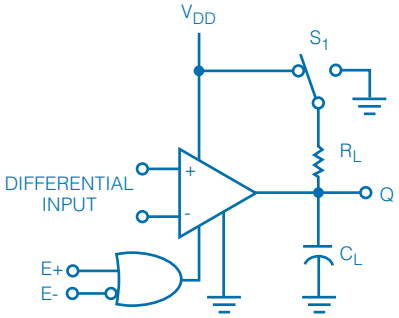
Test Circuits And Diagrams

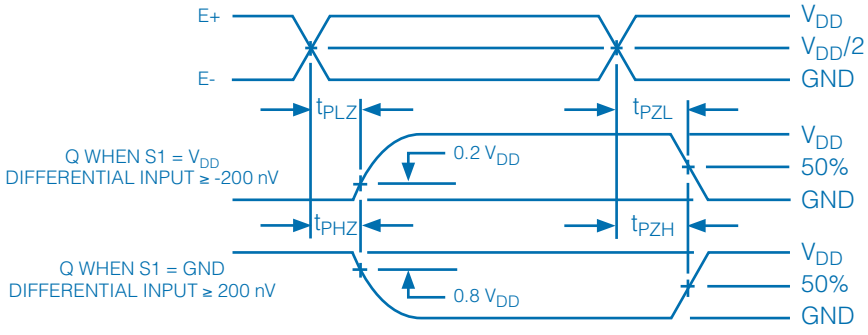
T_{PLH} and T_{PHL} Test Circuit and Waveform



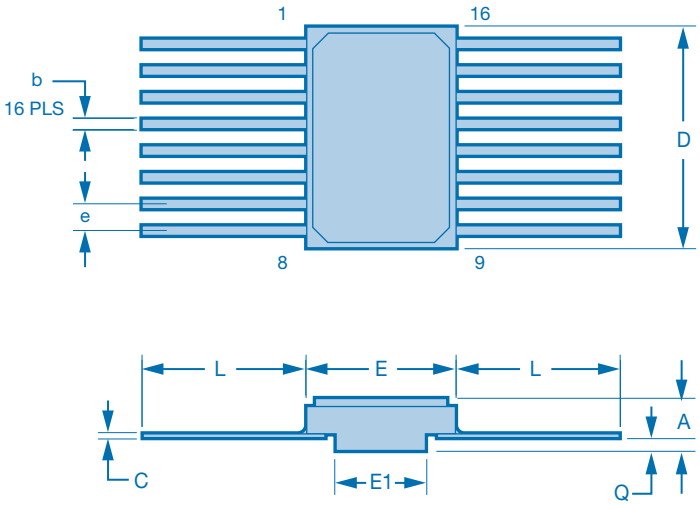


T_{PHZ}, T_{PZH}, T_{PLZ}, and T_{PZL} Test Circuit and Waveform





Package Outline Dimensions



Symbol	Dimensions - Inches Min	Dimensions - Inches Max	Dimensions - Millimeters Min	Dimensions - Millimeters Max
A	.101	.125	2.57	3.18
b	.015	.019	0.38	0.48
c	.004	.007	0.11	0.18
D	.392	.408	9.96	10.36
e	.047	.053	1.20	1.34
E	.274	.286	6.96	7.26
E1	.185	.196	4.70	4.96
L	.320	.360	8.13	9.14
Q	.022	.032	0.56	0.82

Reliability

For many years Honeywell has been producing integrated circuits that meet the stringent reliability requirements of space and defense systems. Honeywell has delivered hundreds of thousands of QML parts since first becoming QML qualified in 1990. Using this proven approach Honeywell will assure the reliability of the products manufactured with the S150 process technology. This approach includes adhering to Honeywell's General Manufacturing Standards for:

- Designing in reliability by establishing electrical rules based on wear out mechanism characterization performed on specially designed test structures (electromigration, TDDB, hot carriers, negative bias temperature instability, radiation)
- Utilizing a structured and controlled design process
- A statistically controlled wafer fabrication process with a continuous defect reduction process
- Individual wafer lot acceptance through process monitor testing (includes radiation testing)
- The use of characterized and qualified packages
- A thorough product testing program based on MIL-PRF-38535 and MIL-STD 883.

Qualification and Screening

The SOI CMOS technology is qualified by Honeywell after meeting the criteria of the General Manufacturing Standards and is also QML Qualified. This qualification is the culmination of years of development, testing, documentation, and on-going process control.

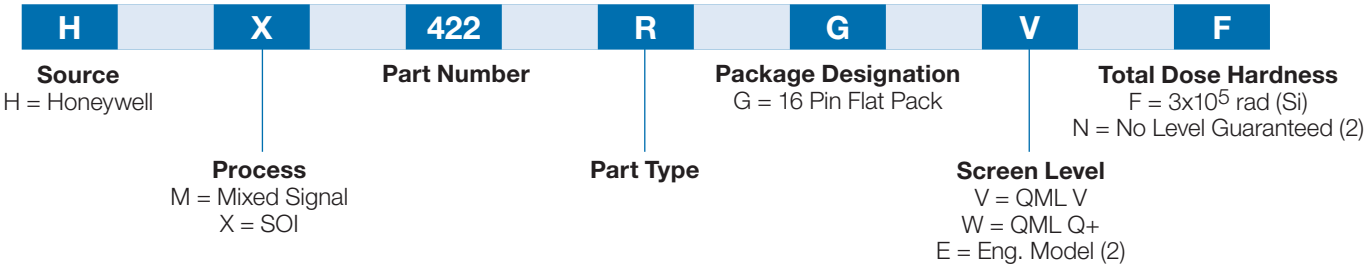
The test flow includes screening units with the defined flow (Class V and Q+) and the appropriate periodic or lot conformance testing (Groups B, C, D, and E). Both the process and the products are subject to period or lot based Technology Conformance Inspection (TCI) and Quality Conformance Inspection (QCI) tests, respectively, as defined by Honeywell's Quality Management Plan.

Honeywell delivers products that are screened to two levels including Engineering Models and Flight Units. EMs are available with limited screening for prototype development and evaluation testing.

Group A	Final Lot Acceptance Electrical Tests
Group B	Mechanical – Dimensions, Bond Strength, Solvents, Die Shear, Solderability, Lead Integrity, Seal, Acceleration
Group C	Life Tests – 1000 hours at 125°C or equivalent
Group D	Package related mechanical tests – Shock, Vibration, Accel, Salt, Seal, Lead Finish Adhesion, Lid Torque, Thermal Shock, Moisture Resistance
Group E	Radiation Tests

(1) Testing performed by package supplier.

Ordering Information



(1) Orders may be faxed to 763-954-2051. Please contact our Customer Service Representative at 1-763-954-2474 for further information.
(2) Engineering Device Description: Parameters are tested -55°C to 125°C, 24 hour burn-in, no radiation guaranteed.

Standard Microcircuit Drawing

The HX422R can be ordered under the SMD drawing 5962-07A04.

QCI Testing (1)

Classification	QCI Testing
QML Q+	No lot specific testing performed. (2)
QML V	Lot specific testing required in accordance with MIL-PRF-38535 Appendix B.

(1) QCI groups, subgroups and sample sizes are defined in MIL-PRF38535 and the Honeywell Quality Management Plan. Quarterly testing is done in accordance with the Honeywell QM Plan.
(2) If customer requires lot specific testing, the purchase order must indicate specific tests and sample sizes.

Find out more

To learn more about Honeywell's radiation hardened integrated circuit products and technologies, visit www.honeywell.com/microelectronics.

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