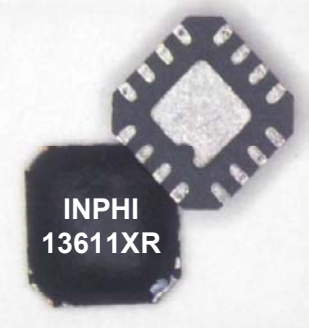
13611XR
13 Gbps XOR/XNOR
Data Sheet



Applications

- High-speed (up to 13 GHz) digital logic
- High-speed (up to 13 Gbps) serial data transmission systems
- Broadband test and measurement equipment

Features

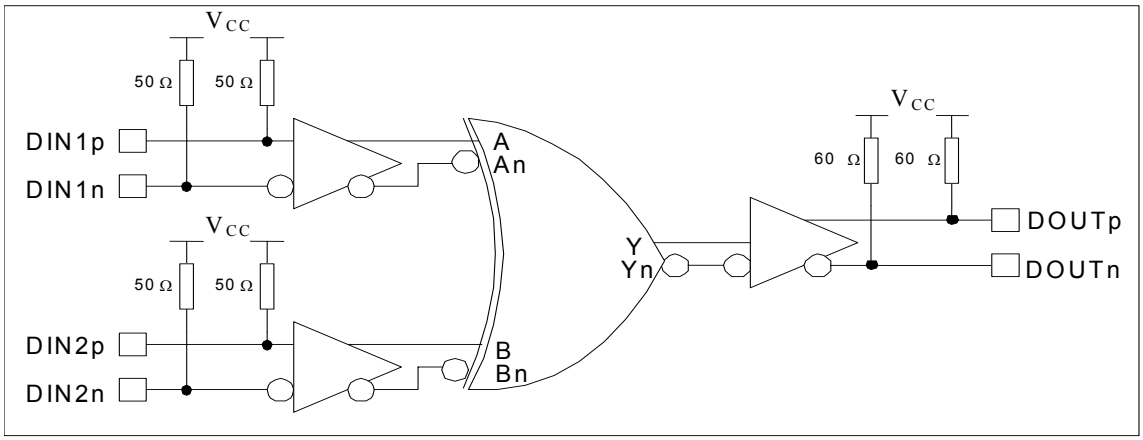
- Supports data rates up to 13 Gbps
- Rise and fall times typically 17/12 ps, respectively
- Power dissipation typically 265 mW
- Supports single-ended and differential operation
- Output signal swing 1200 mVpp differential
- Single, +3.3 V power supply
- Available in QFN package
- Evaluation board available

Description

The 13611XR XOR/XNOR is designed to support data rates up to 13 Gbps. All differential data inputs are DC coupled and terminated on chip with 50 Ω resistors to V_{CC}. The differential data outputs are back-terminated on chip with 60 Ω resistors to V_{CC} (50 ohm impedance). For direct-coupled applications, the outputs should be terminated off chip with 50 ohms to V_{CC}. For applications requiring termination to DC levels other than V_{CC}, externally AC couple the output and terminate with 50 Ω to a good RF ground.

The 13611XR operates from a single +3.3 V power supply and dissipates only 265 mW. It is available in a 3 x 3 mm² quad flat no-lead (QFN) package and is also available on an evaluation board with SMA connectors.

Block Diagram



Absolute Maximum Ratings

- Stresses beyond those listed here may cause permanent damage to the device.
- These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the "Operating Conditions" and "Electrical Specifications" of this datasheet is not implied.
- Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Parameter	Symbol	Conditions	Min	Max	Unit
Power Supply	V_{CC}		–0.5	+3.6	V
Input Signals			V_{CC} – 2	V_{CC} + 1	V
Output Signals			V_{CC} – 2	V_{CC} + 1	V
Junction Temperature – Die	T_J		–5	+175	°C
Case Temperature – Package paddle	T_C	Bottom of paddle	–15	+125	°C
Shipping/Storage Temperature	T_{STORE}		–40	+125	°C
Humidity	RH		0	100	%
ESD Protection (Human Body Model)	ESD	Inputs	500	---	V
		Outputs	250	---	V
		V_{CC}	500	---	V

Operating Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Power Supply Level	V_{CC}	± 5% Tolerance	+3.135	+3.300	+3.465	V
Power Supply Current	I_{EE}		---	80	110	mA
On-Chip Power Dissipation	P_D		---	265	380	mW
Operating Temperature (Junction) – Die	T_J		+15	---	+125	°C
Operating Temperature (Case) – Package	T_C	Bottom of paddle	–5	---	+85	°C
Thermal Resistance – junction to paddle	R_{JC} (θ_{JC})	Bottom of paddle	---	51	---	°C/W

Electrical Specifications

WARNING – To prevent damage to the part:

- DC power must be turned off prior to connecting or disconnecting any cables.

Electrical specifications guaranteed when the part is operated within the specified operating conditions.						
Parameter	**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Maximum Data Rate		10^{-12} BER (NRZ format)	13	---	---	Gbps
Input High Level	V_{IH}		V_{CC} – 0.5	---	V_{CC} + 0.5	V
Input Low Level	V_{IL}		V_{CC} – 1.0	---	V_{CC}	V
Input Amplitude	VIN_{pp}	Differential peak-to-peak	300	---	2000	mVpp
		Single-ended peak-to-peak	300	---	1000	mVpp
Input Return Loss[1]	RL_{IN}	< 13 GHz, with input common mode ≤ V_{CC}.	10	---	---	dB
Output Amplitude[2]	D_{OUT}	Differential peak-to-peak	900	1200	1400	mVpp
Output High Level	V_{OH}	DC coupled, V_{CC} referenced	V_{CC} – 50	V_{CC} – 10	V_{CC}	mV
Output Low Level	V_{OL}	DC coupled, V_{CC} referenced	V_{CC} –700	V_{CC} – 600	V_{CC} – 450	mV
Output Common Mode	V_{OCM}	DC coupled, V_{CC} referenced	---	V_{CC} – 300	---	mV
Output Rise/Fall Time	t_r/t_f	20–80%	---	17/12	30/30	ps
Output Return Loss[3]	RL_{OUT}	< 13 GHz	10	---	---	dB
Deterministic Jitter[4] (Peak-to-Peak)	J_D	V_{IH} = V_{CC} V, V_{IL} = V_{CC} – 0.6 V.	---	3	11	ps
		$V_{IH} \le V_{CC}$+0.3V, $V_{IL} \ge V_{CC}$ –1.0V	---	2	14	ps
		$V_{IH} > V_{CC}$ + 0.3 V.		3	19	ps
Random Jitter[4]	J_R	RMS	---	< 0.6	1.4	ps
Data In to Data Out Delay[5]	t_d	QFN Package	50	65	80	ps
DIN1 to DIN2 Data Skew[5]	t_{SKEW}	Minimize for optimal performance	-5	0	+5	ps

Notes:

[1] Inputs are designed to be a broadband match to 50 ohm impedance and are terminated with a 50 ohm resistor to V_{CC}.

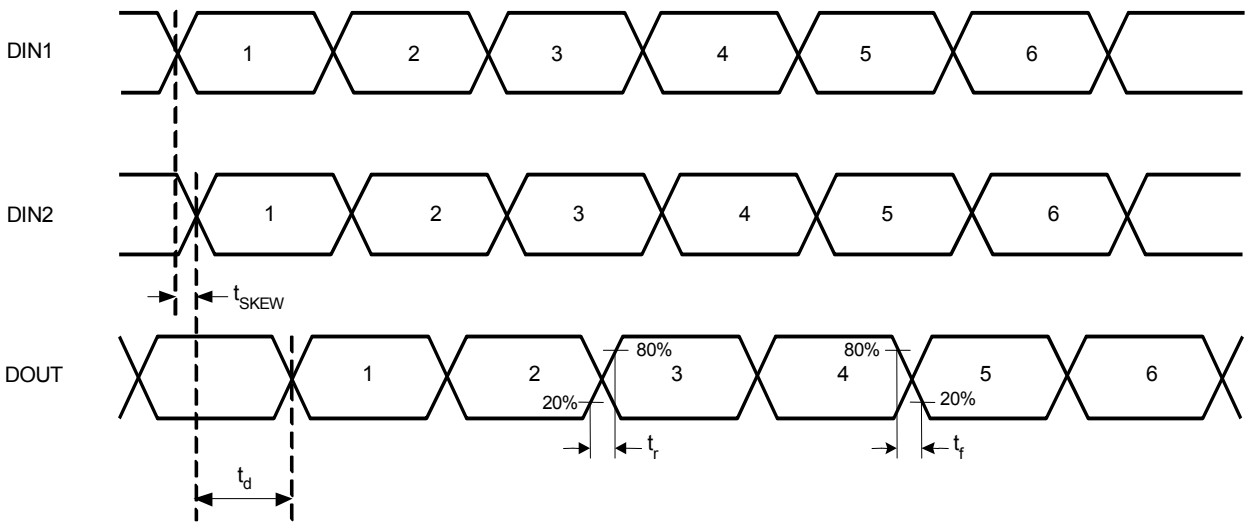
[2] Outputs are CML. Values are based on DC measurements.

[3] Outputs are designed to be a broadband match to 50 ohm impedance and are terminated with a 60 ohm resistor to V_{CC}.

[4] Two-channel jitter with $|t_{SKEW}| < 0.5$ ps.

[5] Specifications based on simulations.

Timing Diagram



Truth Table

Inputs		Outputs	
DIN1	**DIN2**	**DOUTp**	**DOUTn**
L	L	L	H
L	H	H	L
H	L	H	L
H	H	L	H

Notes:
DIN1 = DIN1p – DIN1n
DIN2 = DIN2p – DIN2n
DOUT = DOUTp – DOUTn

H Denotes a HIGH voltage level
L Denotes a LOW voltage level

Typical DC Operating Characteristics

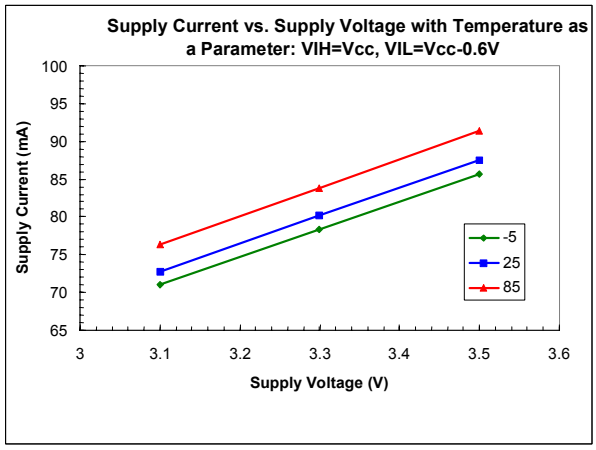


Figure 1. Supply current vs. power supply potential with temperature as a parameter

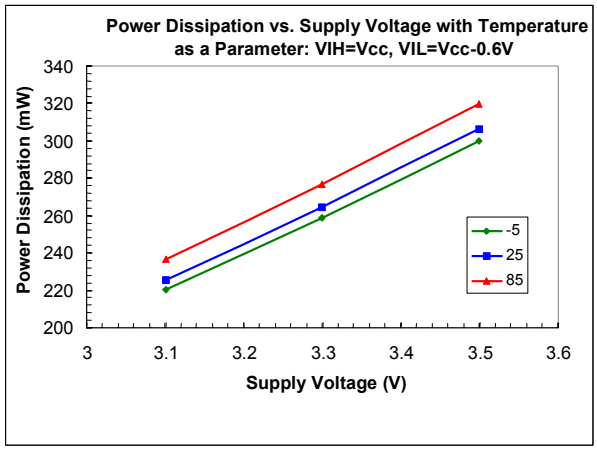


Figure 2. Power dissipation versus power supply with temperature as a parameter

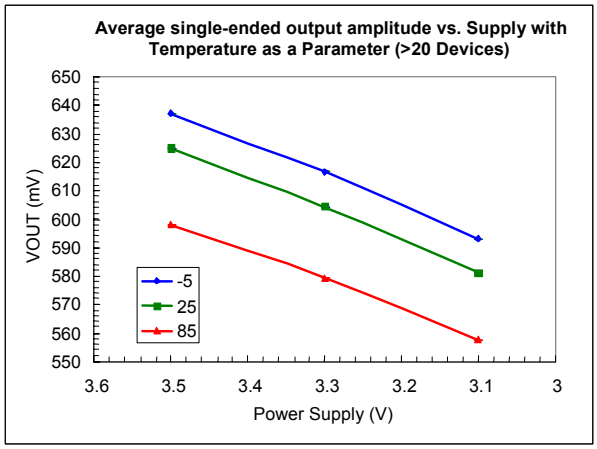


Figure 3. Single-ended output amplitude versus supply and temperature measured statically with a DC voltmeter

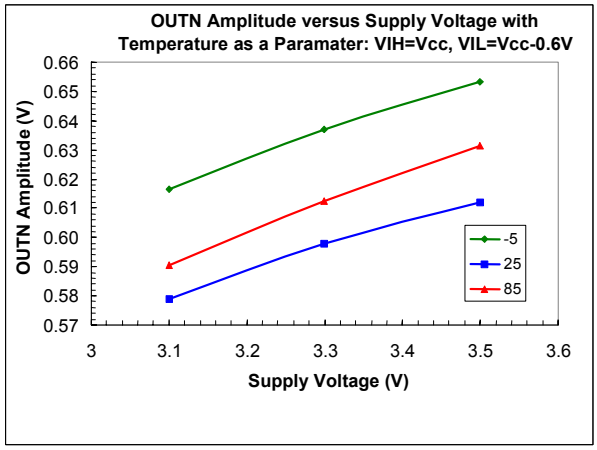


Figure 4. Single-ended output amplitude versus supply and temperature measured with an oscilloscope on 12.5 Gbps PRBS data

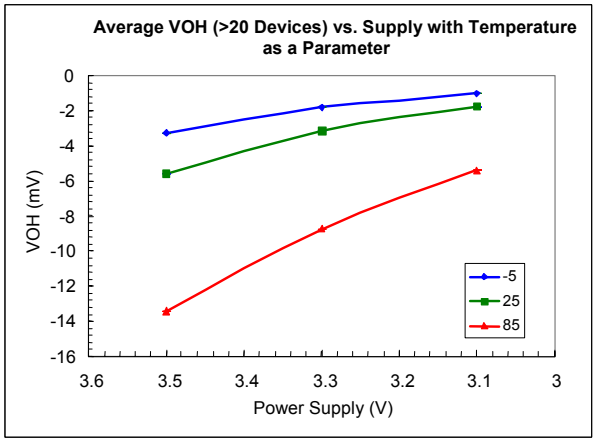


Figure 5. Output high level (V_{OH}) versus power supply with temperature as a parameter

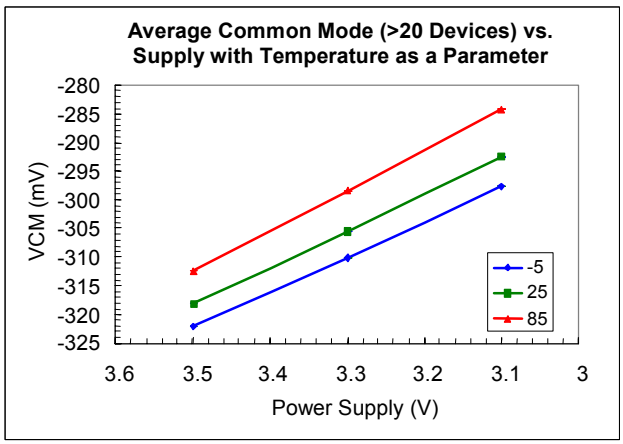


Figure 6. Output common mode versus power supply with temperature as a parameter

Typical Time Domain Operating Characteristics

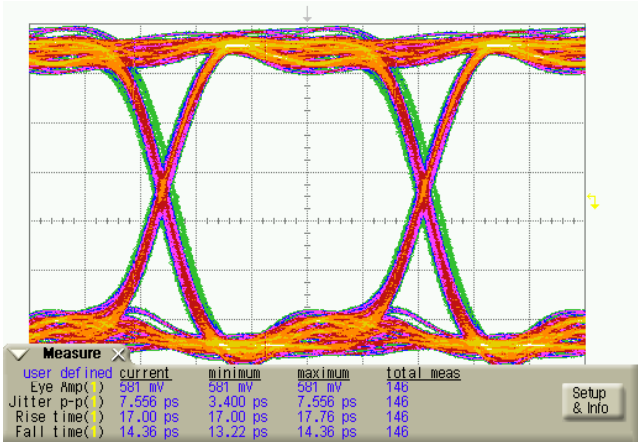


Figure 7. Typical packaged part eye diagram. 12.5 Gbps, PRBS 2^{31}–1, 100mV/div, 17 ps/div.

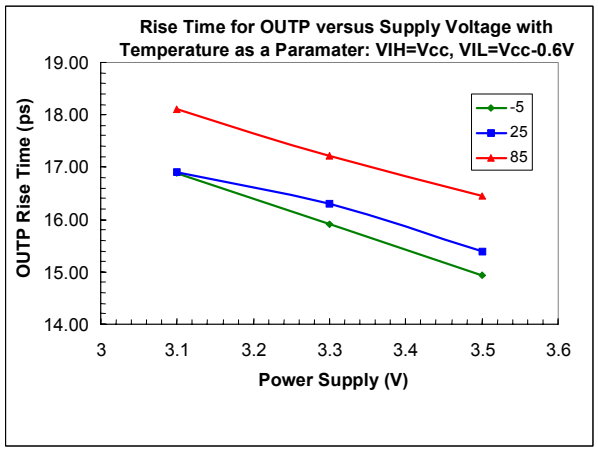


Figure 8. Typical rise time versus power supply with temperature as a parameter

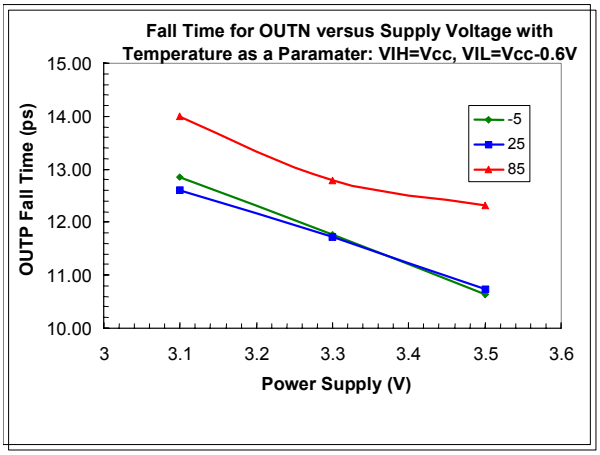


Figure 9. Typical fall time versus power supply with temperature as a parameter

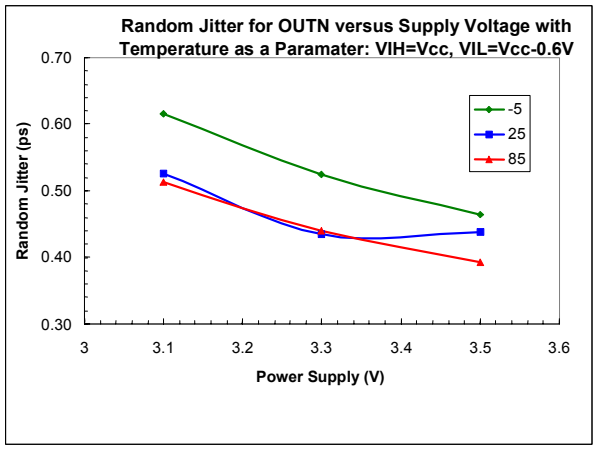


Figure 10. RMS jitter of 12.5 GHz 1010 pattern vs. supply and temperature; RMS jitter of scope and input not removed from the measurement.

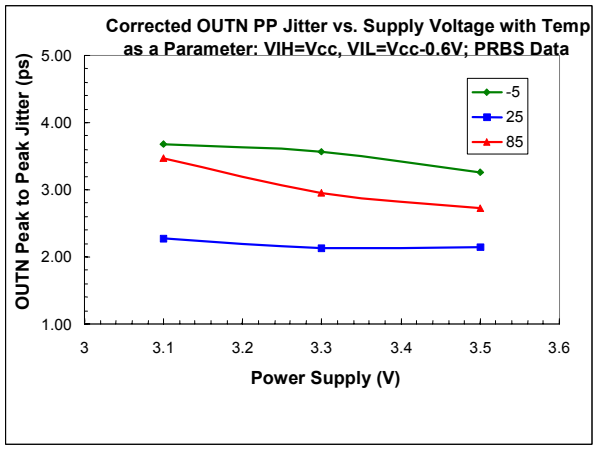


Figure 11. Peak-to-peak jitter of 12.5 Gbps 2^{31}-1 PRBS versus supply and temperature; Jitter of input removed from the measurement.

Input and Output S-parameters

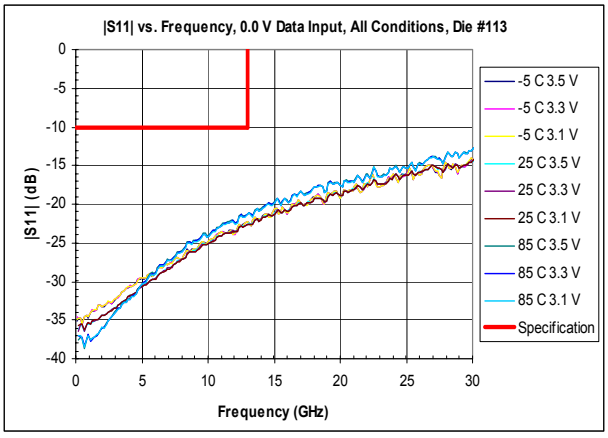


Figure 12. S11 (measured on unpackaged part with RF probes) over temperature and power supply. Input level = 0.0 V

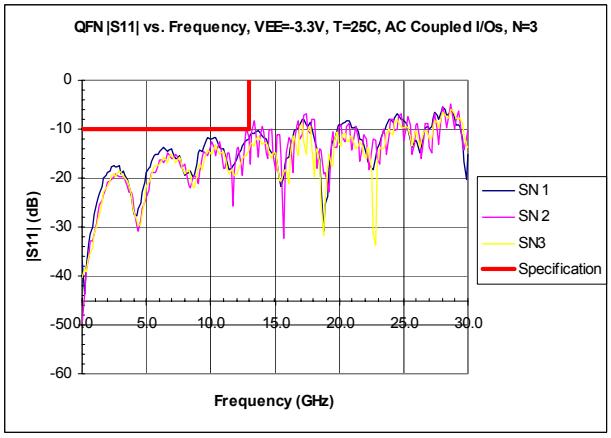


Figure 13. S11 of 3 packaged devices on evaluation boards with input DC level of 0.0 V. Typical operating conditions

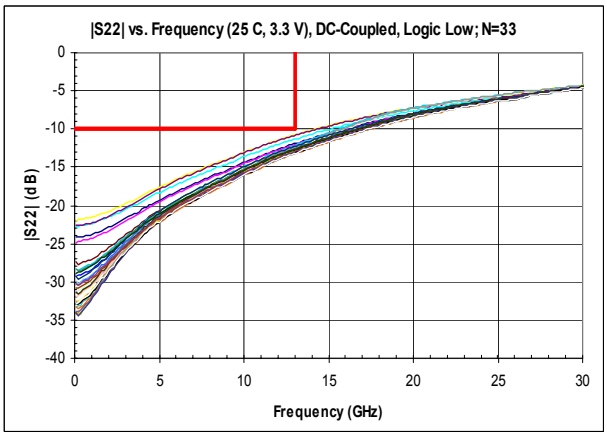


Figure 14. Logic low state S22 (measured on 33 die at wafer level)

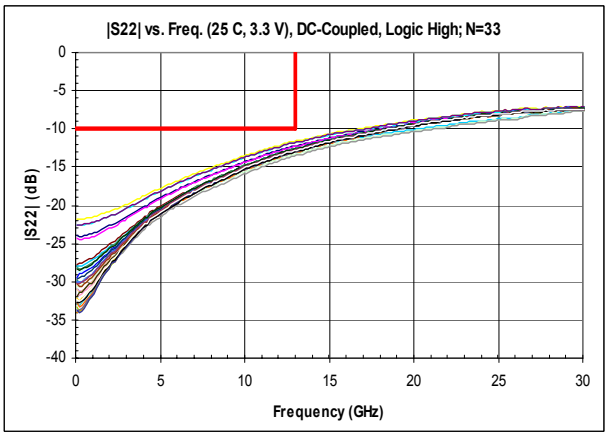


Figure 15. Logic high state S22 (measured on 33 die at wafer level)

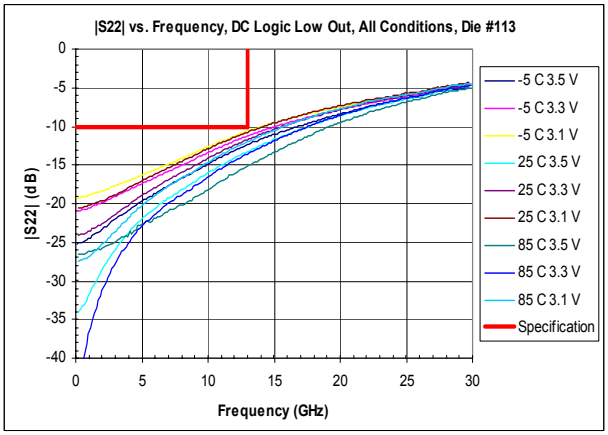


Figure 16. Logic low state S22 measured on one unpackaged device over temperature and supply

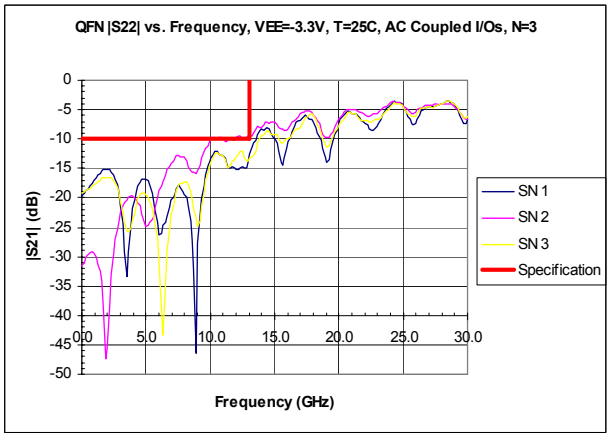
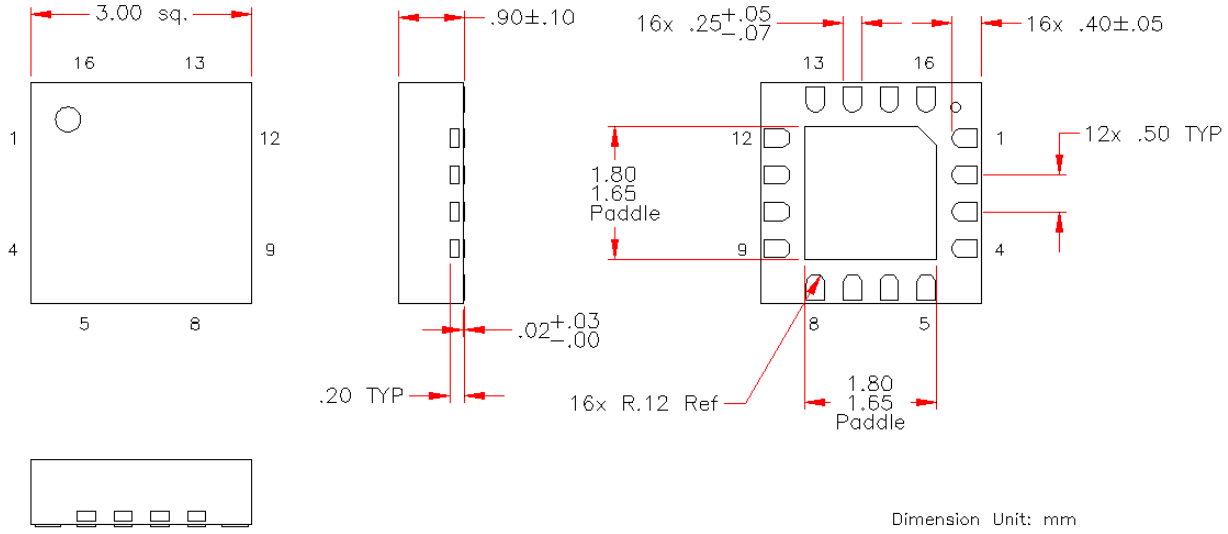


Figure 17. S22 of 3 packaged devices on evaluation boards under typical operating conditions

QFN Package Outline Drawing and Pin Assignment



Name	Pin	Description	Function
DIN1p	3	Non-inverting Data Input, # 1	Input
DIN1n	2	Inverting Data Input, # 1	Input
DIN2p	6	Non-inverting Data Input, # 2	Input
DIN2n	7	Inverting Data Input, # 2	Input
DOUTp	11	Non-inverting Data Output	Output
DOUTn	10	Inverting Data Output	Output
GND	1, 4, 5, 8, 9, 12, 14, Paddle	Ground	Supply
V_{CC}	13, 15, 16	Power Supply: Connect to +3.3 V	Supply

Note:
The paddle must be electrically tied to ground.

Order Information

Part No.	Description
13611XR-S02QFN	13 Gbps XOR/XNOR (+3.3 V Supply) in QFN Package
13611XR-S02QFN-EVB	13 Gbps XOR/XNOR (+3.3 V Supply) in QFN Package on an Evaluation Board with SMA Connectors

Contact Information

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Qualification Notification

The 13611XR-S02 is fully qualified. Please contact Inphi for the qualification report.

Inphi Corporation will honor the full warranty as outlined in Section 5 of Inphi's Standard Customer Purchase Order Terms and Conditions.

Version Updates

From Version 2.0 to 2.1 (dated 5/9/06):

1. Absolute Maximum table (page 2):
   a. Changed Output Signal's minimum level from V_{CC} – 1.5 to V_{CC} – 2 V.
   b. Added ESD specs.
2. Added Thermal Resistance to Operating Conditions table (page 2).
3. Electrical Specifications table (page 3):
   a. Added notes 1 & 3.
   b. Added "Values are based on DC measurements" to note 2.
   c. Changed note numbers on parameter descriptions.
4. Qualification Notification section:
   a. Changed qualification notice to read "fully qualified".
   b. Added statement on radiation tolerance.

Version Updates (cont'd.)

From Version 2.1 to 2.2 (dated 2007-06-11):

1. Corrected Data In to Data Out Delay parameter in Electrical Specifications (page 3):
    a. Removed Die data (conditions and specs.)
    b. Changed specs for QFN package conditions:
        i. Changed Min spec from 90 ps to 50 ps
        ii. Changed Typ spec from 110 ps to 65 ps
        iii. Changed Max spec from 130 ps to 80 ps
2. Removed radiation tolerance statement from Qualification Notification section (page 9).