



QUALITY
SEMICONDUCTOR, INC.

High-Performance CMOS Two-Channel SP4T Mux/Demux

QS4A210Q

FEATURES

- Low On-resistance: $r_{DS(on)} = 5\Omega$
- Fast transition time: $t_{TRAN} = 6ns$
- Wide bandwidth: 700MHz (-3dB point)
- Crosstalk:
-110dB @ 50KHz, -68dB @ 5MHz,
-66dB @ 30MHz
- Off-isolation:
-90dB @ 50KHz, -60dB @ 5MHz,
-50dB @ 30MHz,
- Single 5V supply
- Can be used as a multiplexer or demultiplexer
- TTL compatible control inputs
- Ultra-low quiescent current: 3 μ A

APPLICATIONS

- High-speed video signal switching/routing
- HDTV-quality video signal multiplexing
- Audio signal switching/routing
- Data acquisition
- ATE systems
- Telecom routing
- Switch between multiple video sources
- Token Ring transceivers
- High-speed networking

GENERAL DESCRIPTION

The QS4A210Q is a high-performance CMOS Two-Channel SP4T multiplexer/demultiplexer with individual enables. The low on-resistance of the QS4A210Q allows inputs to be connected to outputs with low insertion loss and high bandwidth. TTL-compatible control circuitry with "Break-Before-Make" feature prevents contention.

The QS4A210Q with 700MHz bandwidth makes it ideal for high-performance video signal switching, audio signal switching, and telecom routing applications. Low power dissipation makes this device ideal for battery operated and remote instrumentation applications.

The QS4A210Q is offered in the QSOP package which has several advantages over conventional packages such as PDIP and SOIC including:

- Reduced signal delays due to denser component packaging on circuit boards
- Reduced system noise due to less pin inductance resulting in lower ground bounce

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Figure 1. Functional Block Diagram

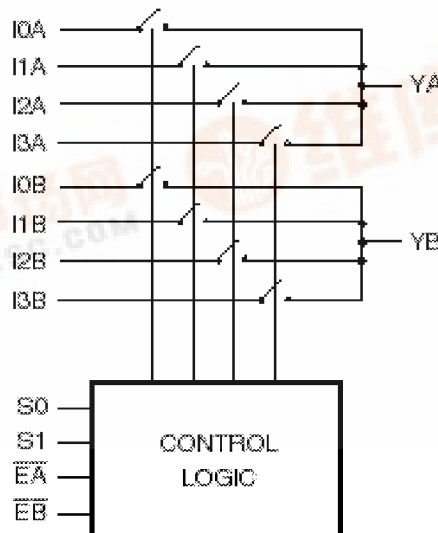


Figure 2. Pin Configuration
(All Pins Top View)

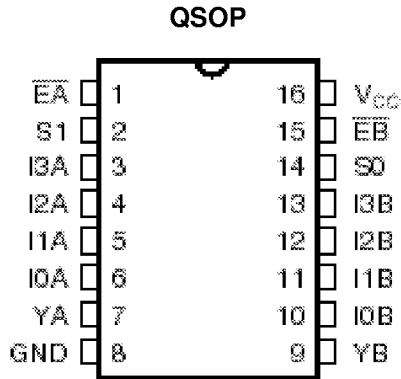


Table 1. Pin Definitions

Name	I/O	Description
IxA	I/O	Demux Port A
IxB	I/O	Demux Port B
EA, EB	I	Enable Inputs
S0, S1	I	Select Inputs
YA, YB	I/O	Mux Port A, B

Table 2. Function Table

Enable		Select		Mux/Demux Ports		Function
EA	EB	S1	S0	YA	YB	
H	X	X	X	High-Z	X	Disable A
X	H	X	X	X	High-Z	Disable B
L	L	L	L	I0A	I0B	S1-0 = 0
L	L	L	H	I1A	I1B	S1-0 = 1
L	L	H	L	I2A	I2B	S1-0 = 2
L	L	H	H	I3A	I3B	S1-0 = 3

Table 3. Absolute Maximum Ratings

Supply Voltage to Ground	-0.5V to +7.0V
DC Switch Voltage V _S	-0.5V to +7.0V
Analog Input Voltage	-0.5V to +7.0V
DC Input Voltage V _{IN}	-0.5V to +7.0V
AC Input Voltage (for a pulse width ≤ 20ns)	-3.0V
DC Output Current Max. Sink Current/Pin	120mA
Maximum Power Dissipation	0.7 watts
T _{STG} Storage Temperature	-65° to +150° C

Note: ABSOLUTE MAXIMUM RATINGS are those conditions beyond which damage to the device may occur. Exposure to these conditions or beyond those indicated may adversely affect device reliability. Functional operation under absolute maximum rating conditions is not implied.

Table 4. Electrical Characteristics Over Operating RangeCommercial: $T_A = 0^\circ\text{C}$ to 70°C , $V_{CC} = 5.0\text{V} \pm 10\%$

Symbol	Parameter	Test Conditions	Min	Typ ⁽¹⁾	Max	Unit
Analog Switch						
V_{IN}	Analog Signal Range ⁽²⁾		-0.5	1.0	$V_{CC}-1$	V
$r_{DS(on)}$	Drain-source On-resistance ^(2,3)	$V_{CC} = \text{Min.}, V_{IN} = 0.0\text{V}, I_{ON} = 30\text{mA}$	—	5	7	Ω
		$V_{CC} = \text{Min.}, V_{IN} = 2.4\text{V}, I_{ON} = 15\text{mA}$	—	5.5	8	Ω
$\Delta r_{DS(on)}$	$r_{DS(on)}$ Matching Between Channels ⁽⁴⁾	$V_{CC} = \text{Min.}, V_{IN} = 0.0\text{V}, I_{ON} = 30\text{mA}$	—	1	—	Ω
		$V_{CC} = \text{Min.}, V_{IN} = 2.4\text{V}, I_{ON} = 15\text{mA}$	—	1	—	Ω
$I_{C(OFF)}$	Channel Off Leakage Current	$I_N = V_{CC}$ or $0\text{V}, Y_N = 0\text{V}$ or V_{CC} $E_A = E_B = V_{CC}$	—	2	—	nA
$I_{C(ON)}$	Channel On Leakage Current	$I_N = Y_N = 0\text{V}$, Each Channel is Turned On Sequentially	—	2	—	nA
Digital Control						
V_{IH}	Input HIGH Voltage	Guaranteed Logic HIGH for Control Pins	2.0	—	—	V
V_{IL}	Input LOW Voltage	Guaranteed Logic LOW for Control Pins	—	—	0.8	V
Dynamic Characteristics						
t_{TRANS}	Switching Time of Mux Sn to Y	$R_L = 1\text{K}\Omega, C_L = 100\text{pF}$ (See Figure 9)	0.5	—	6.6	ns
$t_{ON(E_N)}$	Enable Turn-on Time $E_A = E_B$ to Y	$R_L = 1\text{K}\Omega, C_L = 100\text{pF}$ (See Figure 10)	0.5	—	6.0	ns
$t_{OFF(E_N)}$	Enable Turn-off Time $E_A = E_B$ to Y	$R_L = 1\text{K}\Omega, C_L = 100\text{pF}$ (See Figure 10)	0.5	—	6.0	ns
t_{PD}	Group Delay ^(2,5)	$R_L = 1\text{K}\Omega, C_L = 100\text{pF}$	—	—	250	ns
f_{3dB}	-3dB Bandwidth	$V_{IN} = 1\text{Vp-p}, R_L = 75\Omega$	—	700	—	MHz
	Off-isolation	$V_{IN} = 1\text{Vp-p}, R_L = 75\Omega, f = 5.5\text{MHz}$	—	-60	—	dB
X_{TALK}	Crosstalk	$V_{IN} = 1\text{Vp-p}, R_L = 75\Omega, f = 5.5\text{MHz}$	—	-68	—	dB
$C_{Mux(off)}$	Mux Off Capacitance	$E_A = E_B = V_{CC}, V_{IN} = V_{OUT} = 0\text{V}$	—	5.6	—	pF
$C_{Demux(off)}$	Demux Off Capacitance	$E_A = E_B = V_{CC}, V_{IN} = V_{OUT} = 0\text{V}$	—	7.4	—	pF
$C_{Mux(on)}$	Mux On Capacitance	$E_A = E_B = 0\text{V}, V_{IN} = V_{OUT} = 0\text{V}$	—	12	—	pF
$C_{Demux(on)}$	Mux On Capacitance	$E_A = E_B = 0\text{V}, V_{IN} = V_{OUT} = 0\text{V}$	—	15	—	pF
Q_{CI}	Charge Injection		—	1.5	—	pC

Notes:

1. Typical values indicate $V_{CC} = 5.0\text{V}$ and $T_A = 25^\circ\text{C}$.
2. Guaranteed by design, not subject to production test.
3. Measured by voltage drop between A/B and Y pins at indicated current through the switch. On-resistance is determined by the lower of the voltages on the two (I,Y) pins.
4. $\Delta r_{DS(on)}$ compares on-resistance at the specified V_{IN} Values.
5. The bus switch contributes no group delay other than the RC delay of the on-resistance of the switch and load capacitance. Group delay of the bus switch, when used in a system, is determined by the driving circuit on the driving side of the switch and its interaction with the load on the driven side.

Table 5. Power Supply Characteristics

Symbol	Parameter	Test Conditions ⁽¹⁾	Max	Unit
I_{CCQ}	Quiescent Power	$V_{CC} = \text{Max.}, V_{IN} = \text{GND or } V_{CC}, f = 0$	3	μA

TYPICAL CHARACTERISTICS

Figure 3. Off-isolation and Crosstalk vs. Frequency

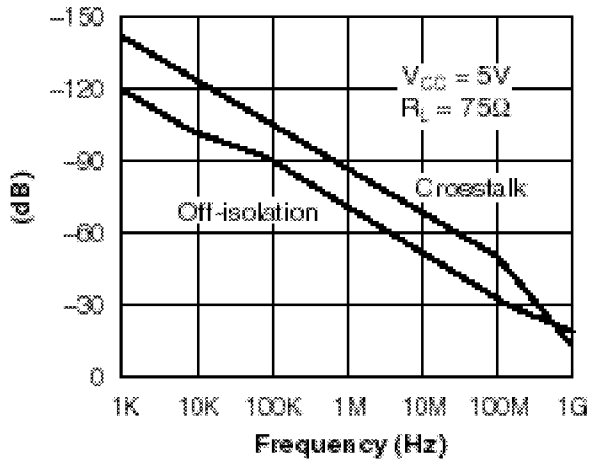
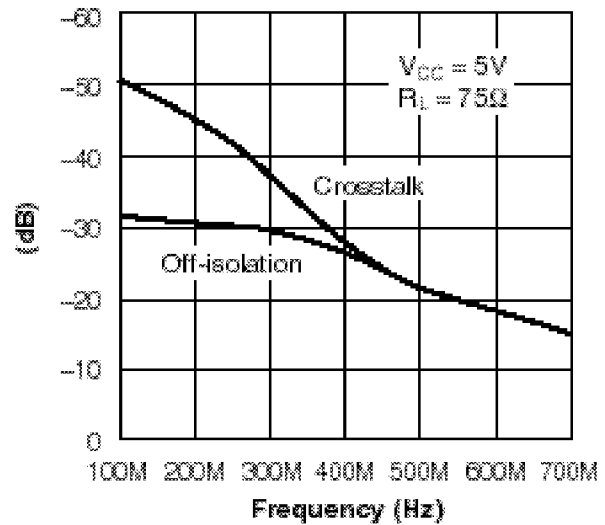


Figure 4. Off-isolation and Crosstalk vs. Frequency



TYPICAL CHARACTERISTICS (continued)

Figure 5. Off-isolation and Crosstalk vs. Frequency

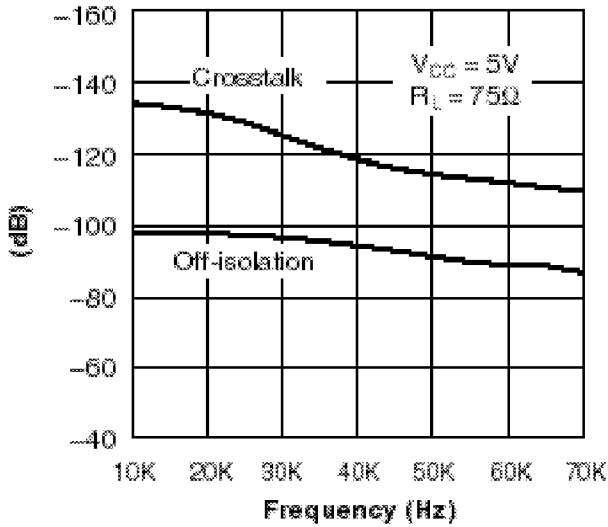
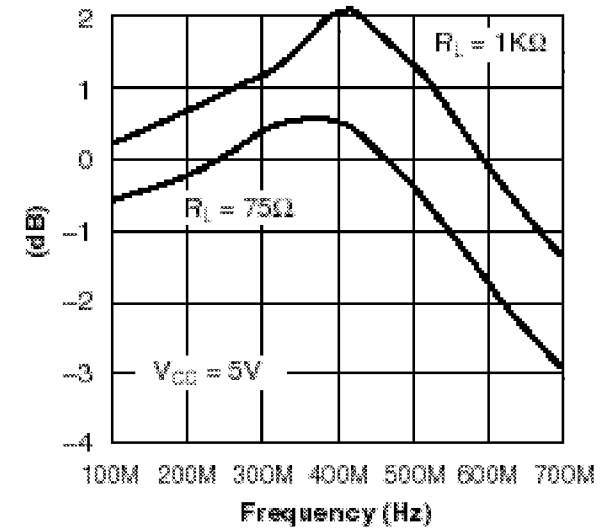


Figure 7. Insertion Loss vs. Frequency



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Figure 6. Insertion Loss vs. Frequency

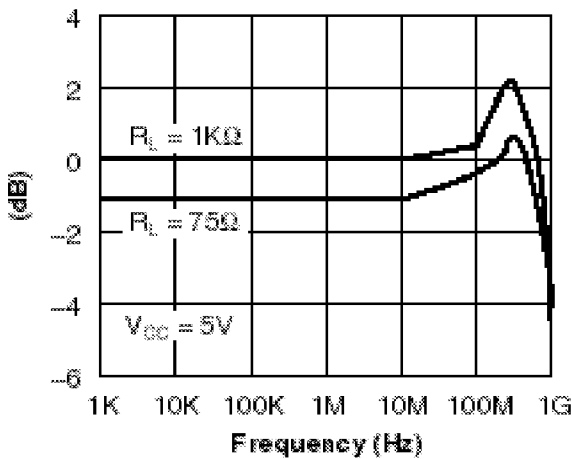
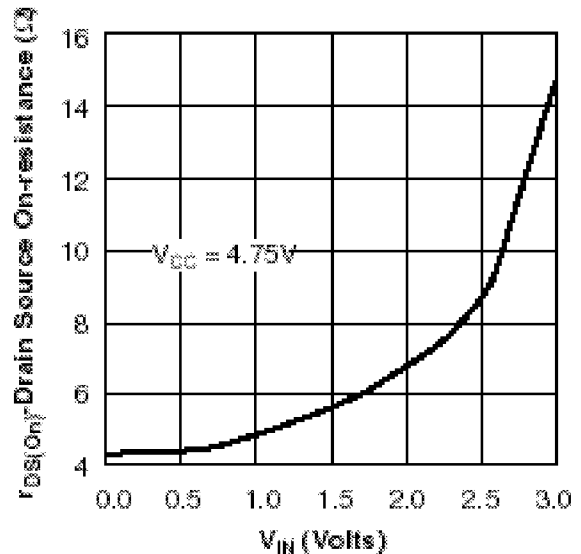


Figure 8. On-resistance vs. V_{IN}



TEST CIRCUITS

Figure 9. Transition Time

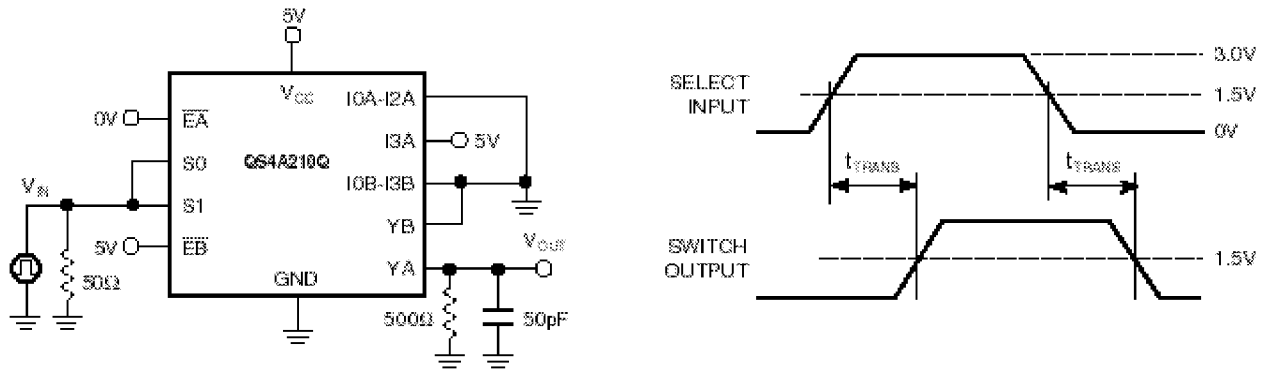


Figure 10. Enable Switching Time

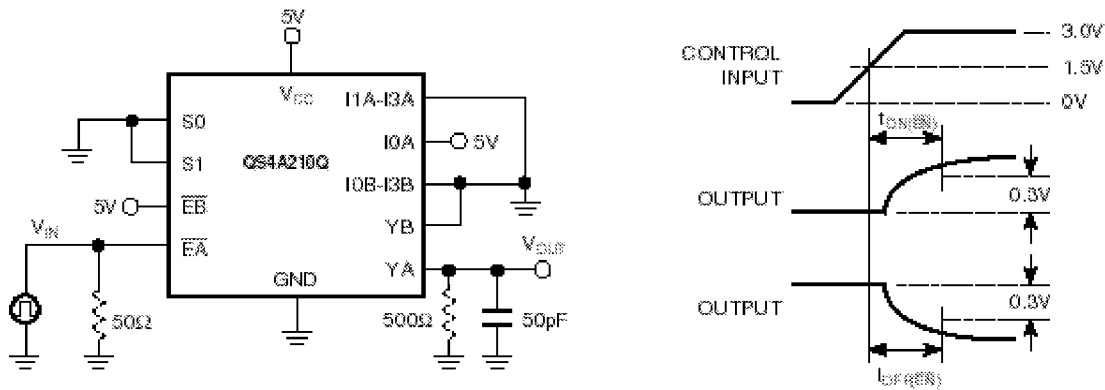
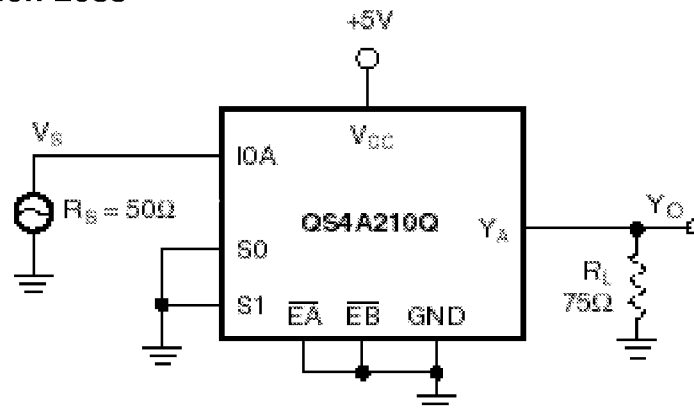


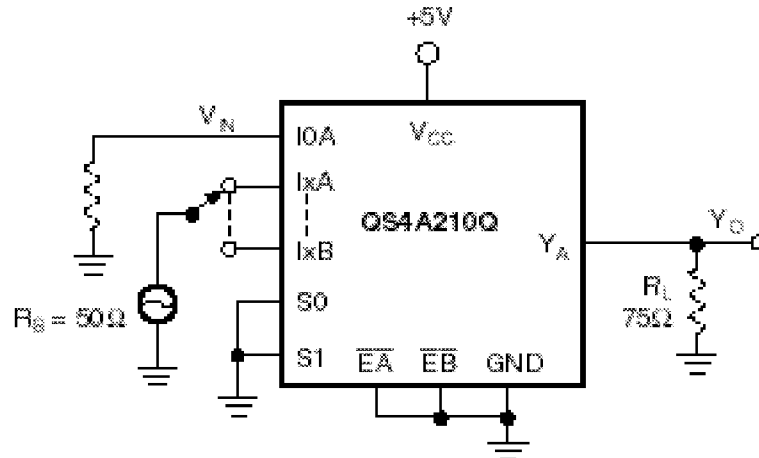
Figure 11. Insertion Loss



Note: Insertion Loss = $20 \log |V_O/V_S|$

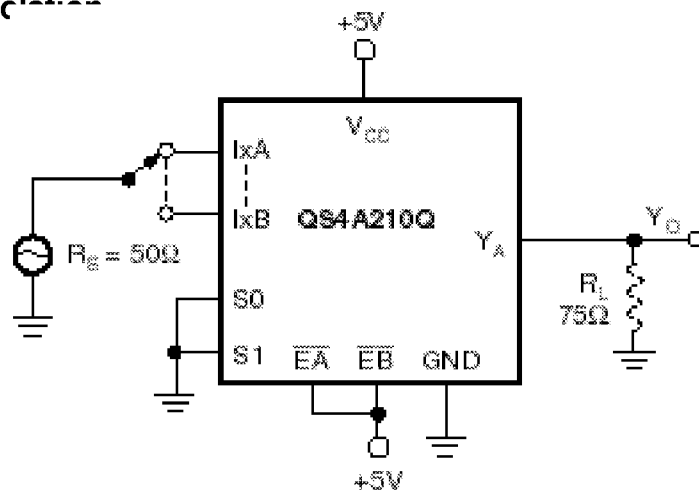
TEST CIRCUITS (continued)

Figure 12. Crosstalk



Note: Crosstalk = $20 \log |V_O/V_S|$

Figure 13. Off-isolation



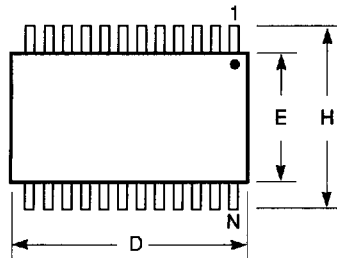
Note: Off-isolation = $20 \log |V_O/V_S|$

**Selection Guide and
Packaging Information**



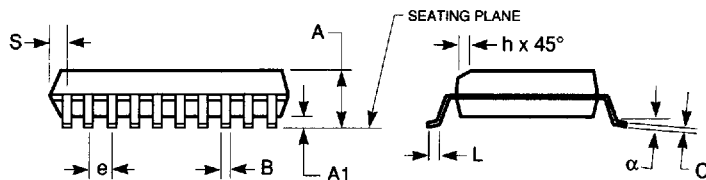
150-MIL QSOP - Package Code Q

Quarter-Size Outline Package
Plastic Small Outline Gull-Wing



Notes:

1. Refer to applicable symbol list.
2. All dimensions are in inches.
3. N is the number of lead positions.
4. Dimensions D and E are to be measured at maximum material condition but do not include mold flash. Allowable mold flash is 0.006in. per side.
5. Lead coplanarity is 0.004in. maximum.



JEDEC#	MO-137AB			MO-137AD			MO-137AE			MO-137AF		
DWG#	PSS-16A			PSS-20A			PSS-24A			PSS-28A		
Symbol	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
A	0.060	0.064	0.068	0.060	0.064	0.068	0.060	0.064	0.068	0.060	0.064	0.068
A1	0.004	0.006	0.008	0.004	0.006	0.008	0.004	0.006	0.008	0.004	0.006	0.008
B	0.009	0.010	0.012	0.009	0.010	0.012	0.009	0.010	0.012	0.009	0.010	0.012
C	0.007	0.008	0.010	0.007	0.008	0.010	0.007	0.008	0.010	0.007	0.008	0.010
D	0.189	0.193	0.197	0.337	0.341	0.344	0.337	0.341	0.344	0.386	0.390	0.394
E	0.150	0.154	0.157	0.150	0.154	0.157	0.150	0.154	0.157	0.150	0.154	0.157
e	0.025 BSC			0.025 BSC			0.025 BSC			0.025 BSC		
H	0.230	0.236	0.244	0.230	0.236	0.244	0.230	0.236	0.244	0.230	0.236	0.244
h	0.010	0.013	0.016	0.010	0.013	0.016	0.010	0.013	0.016	0.010	0.013	0.016
L	0.016	0.025	0.035	0.016	0.025	0.035	0.016	0.025	0.035	0.016	0.025	0.035
N	16			20			24			28		
α	0°	5°	8°	0°	5°	8°	0°	5°	8°	0°	5°	8°
S	0.006	0.009	0.010	0.056	0.058	0.060	0.031	0.033	0.035	0.031	0.033	0.035