



High-Performance CMOS Analog Four-Channel SPDT Mux/Demux

QS4A205Q

FEATURES

- Low on-resistance: $r_{DS(on)} = 5\Omega$
- Fast transition time: $t_{TRAN} = 6ns$
- Wide bandwidth: 830 MHz (−3dB point)
- Crosstalk:
−115dB @ 50KHz, −100dB @ 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: 3μA

APPLICATIONS

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

GENERAL DESCRIPTION

The QS4A205Q is a high-performance CMOS analog Four-Channel SPDT multiplexer/demultiplexer with individual enables. The low on-resistance of the QS4A205Q 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 QS4A205Q with 830MHz bandwidth makes it ideal for high-performance video signal switching, audio signal switching, and telecomm routing applications. High performance and low power dissipation makes this device ideal for battery operated and remote instrumentation applications.

The QS4A205Q is offered in the QSOP package and 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

Figure 1. Functional Block Diagram

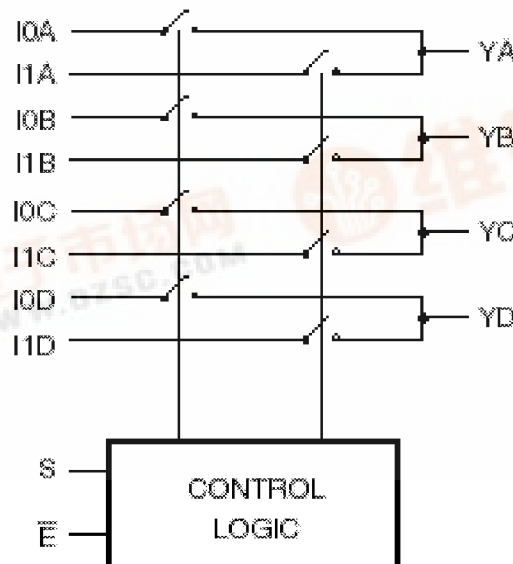


Figure 2. Pin Configuration
(All Pins Top View)

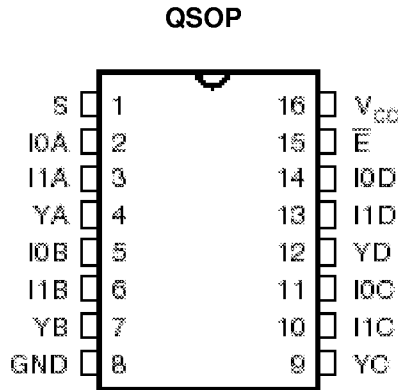


Table 1. Pin Definitions

| Name | I/O | Description |
|-------|-----|--------------|
| IxA | I/O | Demux Port A |
| IxB | I/O | Demux Port B |
| IxC | I/O | Demux Port C |
| IxD | I/O | Demux Port D |
| E | I | Enable Input |
| S | I | Select Input |
| YA-YD | I/O | Mux Port A-D |

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Table 2. Function Table

| Enable | Select | MUX/DEMUX Ports | | | | Function |
|--------|--------|-----------------|--------|--------|--------|----------|
| | | YA | YB | YC | YD | |
| E | S | YA | YB | YC | YD | Function |
| H | X | High-Z | High-Z | High-Z | High-Z | Disable |
| L | L | I0A | I0B | I0C | I0D | Select 0 |
| L | H | I1A | I1B | I1C | I1D | Select 1 |

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 ≤ 20 ns) | -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 Range

Commercial: $T_A = 0^\circ\text{C}$ to 70°C , $V_{CC} = 5.0\text{V} \pm 5\%$

| 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} $E = V_{CC}$ | — | 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 S to Y | $R_L = 1\text{K}\Omega, C_L = 100\text{pF}$ (See Figure 9) | 0.5 | — | 6.6 | ns |
| $t_{ON(EN)}$ | Enable Turn-on Time E to Y | $R_L = 1\text{K}\Omega, C_L = 100\text{pF}$ (See Figure 10) | 0.5 | — | 6.0 | ns |
| $t_{OFF(EN)}$ | Enable Turn-off Time E 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} | -3 dB Bandwidth | $V_{IN} = 1\text{Vp-p}, R_L = 75\Omega$ | — | 830 | — | MHz |
| | Off-isolation | $V_{IN} = 1\text{Vp-p}, R_L = 75\Omega, f = 5\text{MHz}$ | — | -60 | — | dB |
| X_{TALK} | Crosstalk | $V_{IN} = 1\text{Vp-p}, R_L = 75\Omega, f = 5\text{MHz}$ | — | -100 | — | dB |
| $C_{Mux(off)}$ | MUX Off Capacitance | $E = V_{CC}, V_{IN} = V_{OUT} = 0\text{V}$ | — | 5.6 | — | pF |
| $C_{Demux(off)}$ | DEMUX Off Capacitance | $E = V_{CC}, V_{IN} = V_{OUT} = 0\text{V}$ | — | 7.4 | — | pF |
| $C_{Mux(on)}$ | MUX On Capacitance | $E = 0\text{V}, V_{IN} = V_{OUT} = 0\text{V}$ | — | 12 | — | pF |
| $C_{Demux(on)}$ | DEMUX On Capacitance | $E = 0\text{V}, V_{IN} = V_{OUT} = 0\text{V}$ | — | 15 | — | pF |
| Q_{Cl} | 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 I 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 propagation delay other than the RC delay of the on-resistance of the switch and load capacitance. Propagation 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

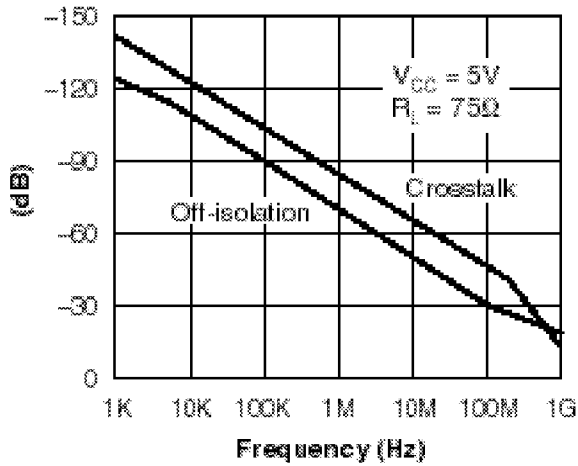
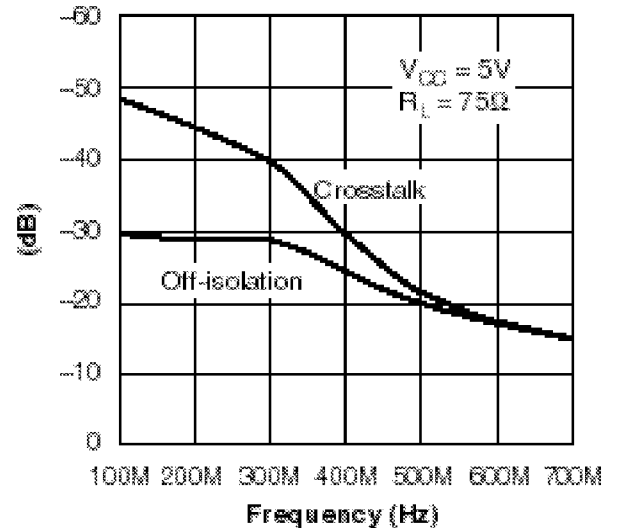


Figure 4. Off-isolation and Crosstalk vs. Frequency



TYPICAL CHARACTERISTICS (continued)

Figure 5. Off-isolation and Crosstalk vs. Frequency

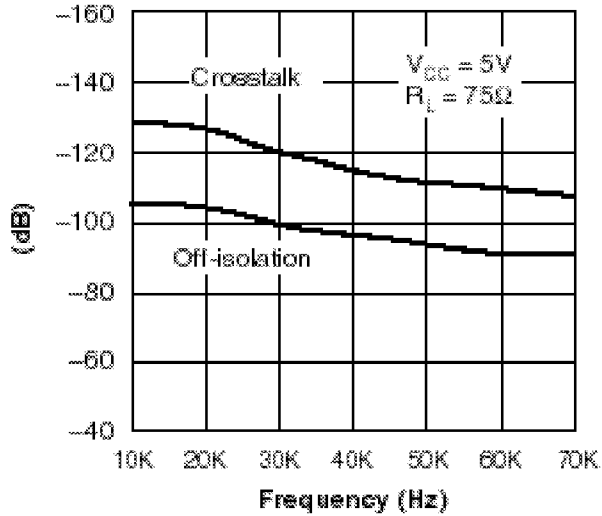


Figure 6. Insertion Loss vs. Frequency

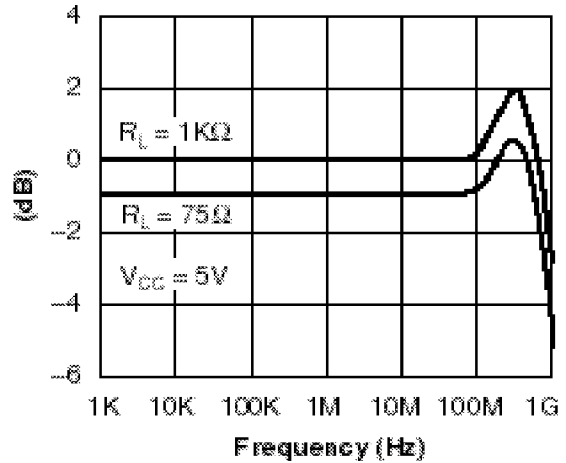


Figure 7. Insertion Loss vs. Frequency

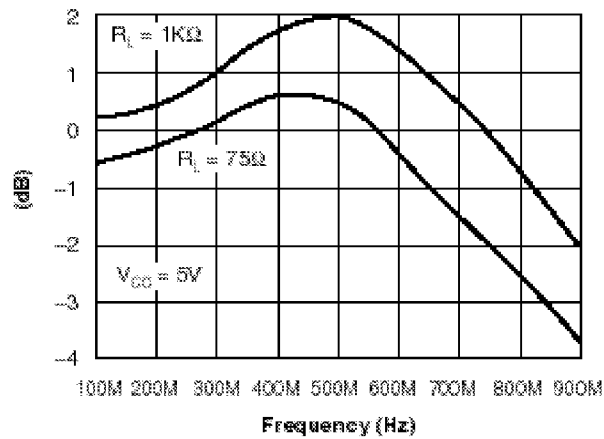
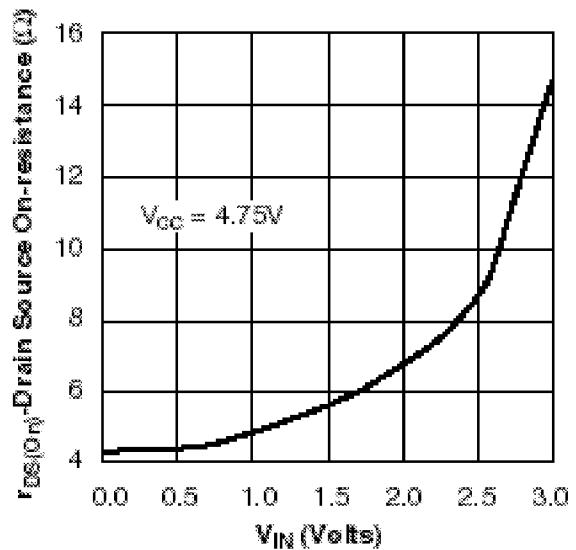


Figure 8. On-resistance vs. V_{IN}



TEST CIRCUITS

Figure 9. Transition Time

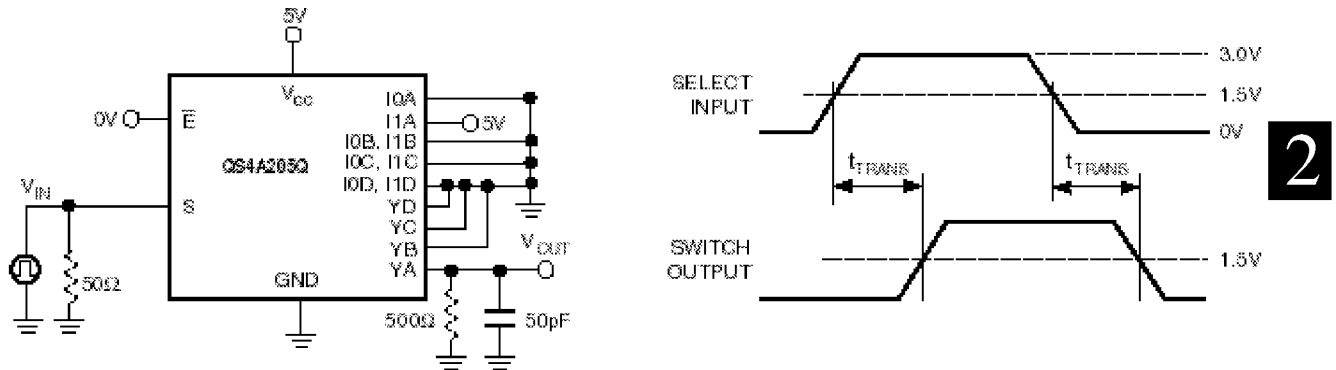


Figure 10. Enable Switching Time

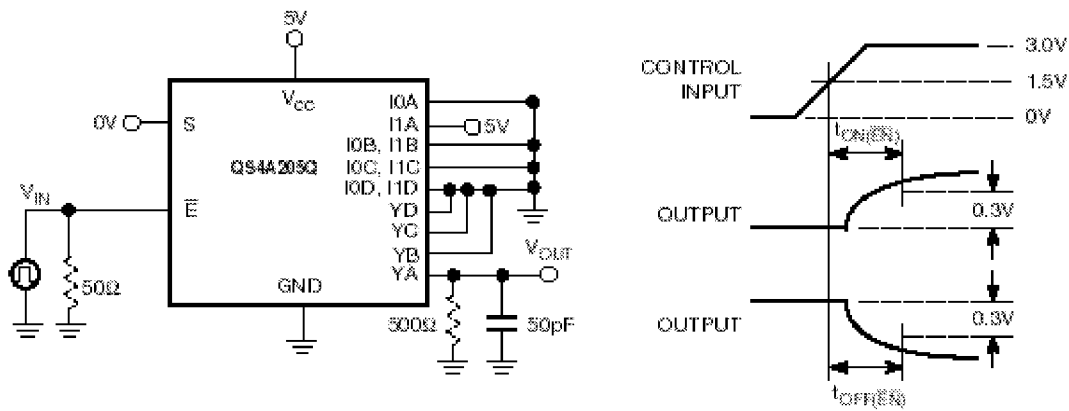
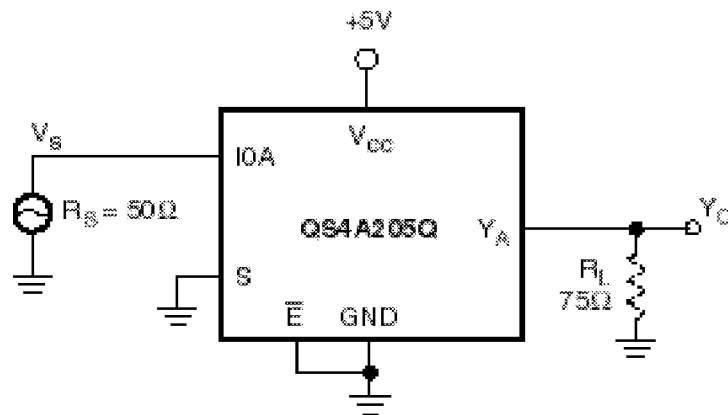


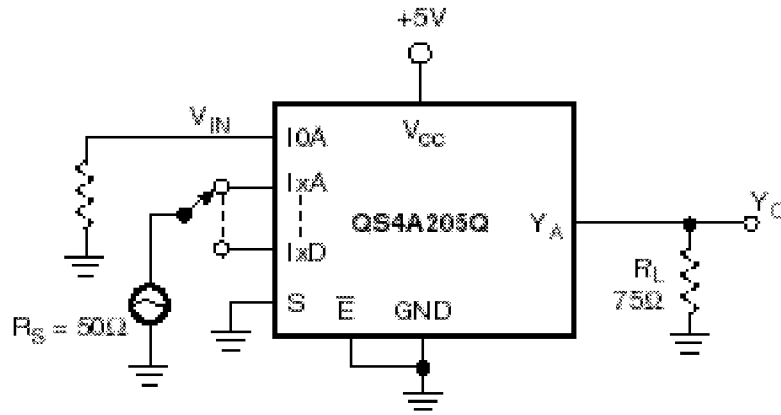
Figure 11. Insertion Loss



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

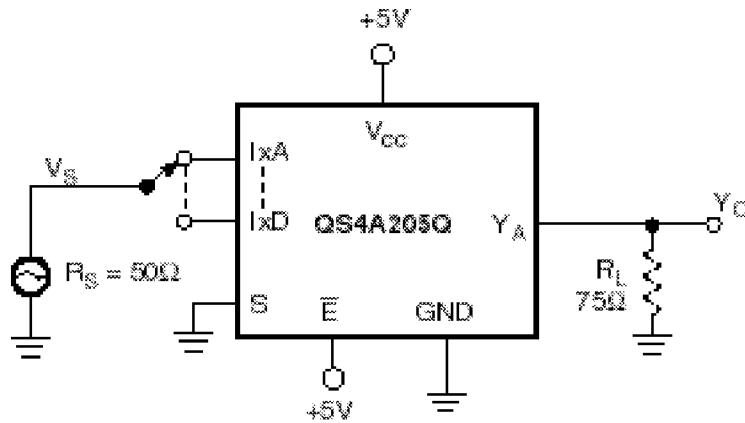
TEST CIRCUITS (continued)

Figure 12. Crosstalk



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

Figure 13. Off-isolation



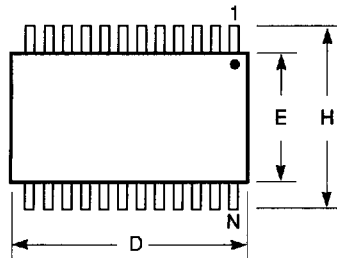
Note: Off-isolation = $20 \log |V_O/V_S|$

**Selection Guide and
Packaging Information**



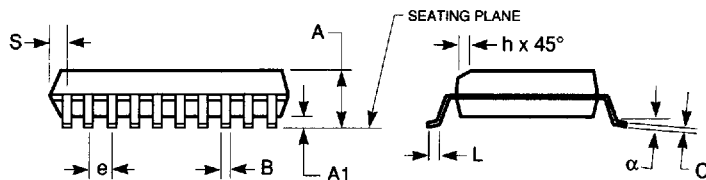
150-MIL QSOP - Package Code Q

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 |