

#### **WAS7222Q**

#### USB High speed (480Mbps), DPDT Analog Switch

#### **Descriptions**

The WAS7222Q is a high performance, double pole double throw (DPDT) CMOS analog switch that operates from a single +2.3V to +5.5V power supply.

The WAS7222Q is designed for switching of high-speed USB2.0 signals in handset and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers with limited USB I/Os.

The WAS7222Q has low bit-to-bit skew and high channel-to-channel noise isolation, and is compatible with various standards, such as high-speed USB 2.0 (480Mbps). Each switch is bi-directional and offers little attenuation of the high-speed signals at the outputs. Its bandwidth is quite marginal to pass high-speed USB 2.0 differential signals (480Mbps) with good signal integrity.

The WAS7222Q is featured with special circuitry on the D+/D-, which allows the device to withstand a VBUS short to D+ or D- when the USB devices are either powered off or on.

The SEL/OE pin has overvoltage protection that allows voltages above VCC, up to 7.0V to be present on the pin without damage or disruption of operation of the part, regardless of the operating voltage. The WAS7222Q is also featured with smart circuitry to minimize VCC leakage current even when SEL/OE control voltage is lower than VCC supply voltage. In other word, there is no need of additional device to shift SEL/OE level to be the same as that of VCC in real application.

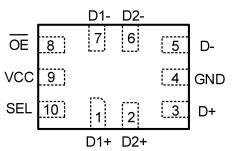
The WAS7222Q is available in QFN1418-10L package. Standard products are Pb-Free and halogen-Free.

## **Applications**

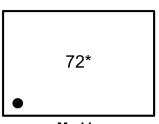
- Cell phones
- MID
- Router
- Other electronics equipments

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Pin configuration (Top view)



Marking

72 = Device code

\* = Month (A~Z)

## **Order information**

Device	Package	Shipping		
WAS7222Q-10/TR	QFN1418-10L	3000/Reel&Tape		

#### **Features**

Supply voltage : 2.3 ~ 5.5V

-3dB Bandwidth : 550MHz @ C<sub>L</sub>=5pF
 Off isolation : -36dB @ 250MHz
 Crosstalk : -47dB @ 250MHz

Low quiescent current : <1uA</li>



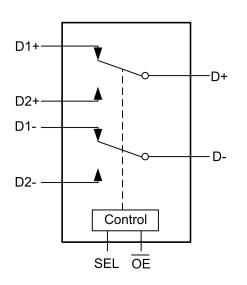
## Pin descriptions

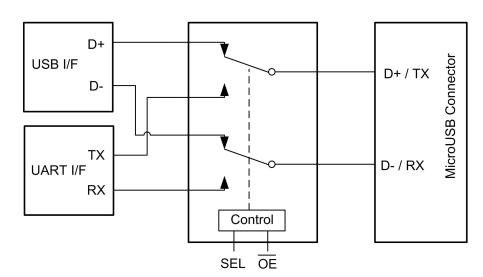
Pin Number	Symbol	Descriptions
1	D1+	Port A data 1 terminal, normally closed
2	D2+	Port A data 2 terminal, normally open
3	D+	Port A common data terminal, Connect to D1+ or D2+ according to SEL logic
4	GND	Ground
5	D-	Port B common data terminal, Connect to D1- or D2- according to SEL logic
6	D2-	Port B data 2 terminal, normally open
7	D1-	Port B data 1 terminal, normally closed
8	ŌE	Enable control, Active low
9	VCC	Power supply
10	SEL	Switch select pin, digital logic low or high.

## **Function descriptions**

SEL	ŌE	Function	
X	Н	Bus switch disconnected	
L	L	D+ connect to D1+ and D- connect to D1-	
Н	L	D+ connect to D2+ and D- connect to D2-	

## Logic symbol and typical applications





Logic Symbol

**Typical Applications** 



Absolute maximum ratings

Parameter	Symbol	Value	Unit
Supply voltage range	VCC	VCC -0.5 ~ 6.5	
Data input/output voltage range	$V_{DATA}$	-0.5 ~ 6.5	V
Select input voltage range	V <sub>SEL</sub>	-0.5 ~ 6.5	V
Continues output current	Гоит	±50	mA
Junction temperature range	TJ	T <sub>J</sub> 150	
Lead temperature range	TL	260	°C
Storage temperature range	T <sub>STG</sub>	-65 ~ 150	°C
Thermal resistance	R <sub>θJA</sub>	250	°C/W
	I/O to VCC, I/O to GND	±7000	V
ESD protection (HBM)	I/O to I/O	±5000	V

**Recommend operating ratings** 

Parameter	Symbol	Value	Unit
Supply voltage range	VCC	2.3 ~ 5.5	V
Data input/output voltage range	$V_{DATA}$	0.0 ~ VCC	V
Select input voltage range	Vsel	0.0 ~ VCC	V
Enable control input voltage range	V <sub>OE</sub>	0.0 ~ VCC	V
Operating temperature range	T <sub>A</sub>	-40 ~ 85	°C

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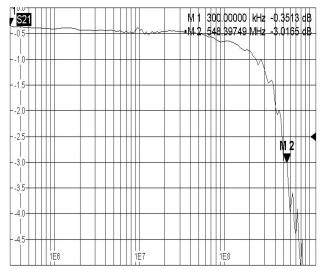
## Electronics Characteristics (Ta=25°C, VCC=4.5V, unless otherwise noted)

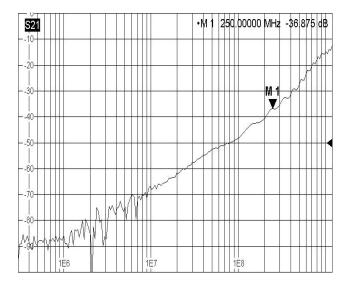
Select and OE logic high level   Vi	Parameter	Symbol	Conditions	Min.	Тур.	Max.	Unit
VCC=2.3~3.0	Salast and OF logic high level	V	VCC=3.0∼4.5	1.6			V
Select and OE logic low level   Vit   VCC=2.3~3.0   0.4   V   VCC=2.3~3.0     0.4   V   V   V   V   V   V   V   V   V	Select and OE logic high level	VIH	VCC=2.3∼3.0	1.4			V
VCC=2.3~3.0   0.4   V	Onlant and OF India Invalous		VCC=3.0∼4.5			0.6	V
Supply quiescent current   Icc   Vsel. > 1.5 V or Vsel. < 0.7 V	Select and OE logic low level	VIL	VCC=2.3∼3.0			0.4	V
Supply quiescent current			I <sub>OUT</sub> =0,				
Select input leakage current   I_{SEL}   V_{SEL*OCC}	Supply guidesent current		V <sub>SEL</sub> >1.5V or			1.0	
Select input leakage current   Isel	Supply quiescent current	ICC	V <sub>SEL</sub> <0.7V				uA
Off state switch leakage current         IoFF         See figure 2         ±1.0         uA           On state switch leakage current         IoN         See figure 3         ±1.0         uA           On-Resistance         RoN         VCC=3.0V, VDATA=0~0.4V, IOUT=8MA, See figure 4         5.0         7.5         Ω           On-Resistance match         A RoN         VCC=3.0V, VDATA=0~0.4V, IOUT=8MA, See figure 4         0.15         0.20         Ω           On-Resistance flatness         RFLAT(ON)         VDATA=0~1.0V, IOUT=8MA, See figure 4         1.8         2.2         Ω           Propagation delay time         TPLH / TPHL         CL=10pF, RL=50Ω See figure 5         0.3         1.2         ns           Select input to switch on time         TON         CL=10pF, RL=50Ω See figure 5         0.3         1.2         ns           Select input to switch off time         TOFF         CL=10pF, RL=50Ω See figure 6         75         120         ns           Select input to switch off time         TOFF         CL=10pF, RL=50Ω See figure 6         0.5         ns           Select input to switch off time         TOFF         CL=10pF, RL=50Ω See figure 6         0.5         ns           Select input to switch off time         TOFF         CL=10pF, RL=50Ω See figure 6         0.5         ns </td <td></td> <td></td> <td>Refer to figure1</td> <td></td> <td></td> <td></td> <td></td>			Refer to figure1				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Select input leakage current	I <sub>SEL</sub>	V <sub>SEL</sub> =VCC			±1.0	uA
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Off state switch leakage current	I <sub>OFF</sub>	See figure 2			±1.0	uA
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	On state switch leakage current	I <sub>ON</sub>	See figure 3			±1.0	uA
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			VCC=3.0V,				
Iour=8mA,   See figure 4   VCC=3.0V,   VDATA=0~0.4V,   IOUT=8mA,   See figure 4   VCC=3.0V,   VDATA=0~0.4V,   IOUT=8mA,   See figure 4   VCC=3.0V,   VDATA=0~1.0V,   IOUT=8mA,   See figure 5   UCT=10pF, RL=50Ω   See figure 5   VCC=10pF, RL=50Ω   See figure 6   VCC=3.0V,   See figure 6   VCC=3.0V,   VDATA=0~1.0V,   IOUT=8mA,   See figure 6   VCC=10pF, RL=50Ω   See figure 6   VCC=10pF, RL=50Ω   See figure 6   VCC=3.0V,   VDATA=0~1.0V,   IOUT=3.0V,   IOUT=3.0V,   VDATA=0~1.0V,   IOUT=3.0V,   VDATA=0~1.0V,   IOUT=3.0V,   VDATA=0~1.0V,   IOUT=3.0V,   I	On Basistanas		V <sub>DATA</sub> =0~0.4V,		5.0	7.5	Ω
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	On-Resistance	RON	I <sub>OUT</sub> =8mA,		5.0	7.5	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			See figure 4				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			VCC=3.0V,				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	O. Basistana a matet		V <sub>DATA</sub> =0~0.4V,		0.45	0.00	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	On-Resistance match	$\Delta$ R <sub>ON</sub>	I <sub>OUT</sub> =8mA,		0.15	0.20	Ω
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			See figure 4				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			VCC=3.0V,				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	O. D. data and flat		V <sub>DATA</sub> =0~1.0V,	1.8			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	On-Resistance flatness	RFLAT(ON)	I <sub>OUT</sub> =8mA,		1.8	2.2	Ω
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			See figure 4				
Select input to switch on time $T_{ON} = \begin{array}{c} C_L = 10 pF, R_L = 50 \Omega \\ See \ figure \ 6 \end{array} \qquad \begin{array}{c} 75 \\ 120 \end{array} \qquad \text{ns}$ $Select \ input \ to \ switch \ off \ time \qquad T_{OFF} = \begin{array}{c} C_L = 10 pF, R_L = 50 \Omega \\ See \ figure \ 6 \end{array} \qquad \begin{array}{c} 40 \\ See \ figure \ 6 \end{array} \qquad \begin{array}{c} 80 \\ See \ figure \ figur$	5		C <sub>L</sub> =10pF, R <sub>L</sub> =50Ω		0.0	4.0	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Propagation delay time	I PLH / I PHL	See figure 5		0.3	1.2	ns
$See \ figure \ 6$ $Select \ input \ to \ switch \ off \ time$ $T_{OFF}$ $See \ figure \ 6$ $C_L=10pF, \ R_L=50\Omega$ $See \ figure \ 6$ $R_L=50\Omega, \ C_L=5pF$ $R_L=50\Omega, \ C_L=5pF$ $R_L=50\Omega, \ C_L=0pF$ $R_L=50\Omega, \ C_L=0pF$ $R_L=50\Omega, \ F=250MHz$ $Crosstalk$ $Stalk$ $S$	0.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1	_	C <sub>L</sub> =10pF, R <sub>L</sub> =50Ω		7.5	400	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Select input to switch on time	I <sub>ON</sub>	See figure 6		/5	120	ns
$See \ figure \ 6$ Break-Before-Make time $T_{BBM} \qquad Generated \ by \ design \qquad 0.5 \qquad ns$ $-3dB \ Bandwidth \qquad BW \qquad \frac{R_L=50\Omega, \ C_L=5pF}{R_L=50\Omega, \ C_L=0pF} \qquad 800 \qquad MHz$ Off isolation $OIRR \qquad R_L=50\Omega, \ F=250MHz \qquad -36 \qquad dB$ Crosstalk $Xtalk \qquad R_L=50\Omega, \ F=250MHz \qquad -47 \qquad dB$ Charge injection $Qg \qquad C_L=0.1nF, \ VCC=3.3V \qquad 5 \qquad pC$ Select input to common I/O) $R_G=0\Omega, \ V_G=GND \qquad 5 \qquad pF$ D1n, D2n,Dn Off capacitance $C_{OFF} \qquad VCC=3.3V, \ \overline{OE}=3.3V \qquad 5 \qquad pF$	0.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1	_	C <sub>L</sub> =10pF, R <sub>L</sub> =50Ω		10		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Select input to switch off time	I OFF	See figure 6		40	80	ns
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Break-Before-Make time	T <sub>BBM</sub>	Generated by design	0.5			ns
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0.15.5	514	$R_L=50\Omega$ , $C_L=5pF$		550		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	-3dB Bandwidth	BW	$R_L=50\Omega$ , $C_L=0pF$		800		MHZ
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Off isolation	OIRR	R <sub>L</sub> =50Ω, F=250MHz		-36		dB
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Crosstalk	Xtalk	·		-47		dB
	Charge injection		C <sub>L</sub> =0.1nF, VCC=3.3V		_		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	• •	Qg	·		5		pC
D1n, D2n,Dn Off capacitance $C_{OFF}$ VCC=3.3V, $\overline{OE}$ =3.3V 5 pF		C <sub>IN</sub>	· · · · · · · · · · · · · · · · · · ·		5		pF
	, , , ,	+			5		<u> </u>
	D1n, D2n,Dn On capacitance	Con	VCC=3.3V, OE=0V		6.5		pF

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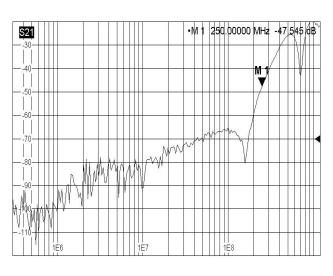
## Typical Characteristics (Ta=25°C, VCC=4.5V, unless otherwise noted)

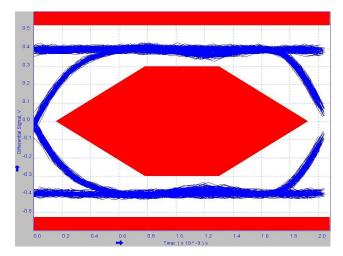




**Bandwidth** 







Crosstalk

#### Eye Diagram (480Mbps)

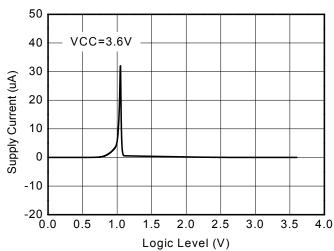
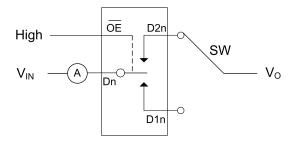


Figure 1: Supply current vs. Logic level



#### **Test Circuit**



Conditions:  $V_{IN}$ =4.5V, VO=GND

Low SEL D2n Vo

Conditions:  $V_{IN}$ =4.5V,  $V_{O}$ =Open

Figure 3: On state switch leakage current

Figure 2: Off state switch leakage current

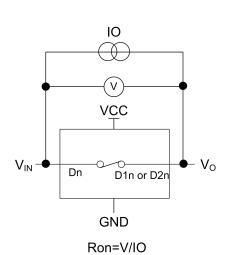


Figure 4: On-Resistance

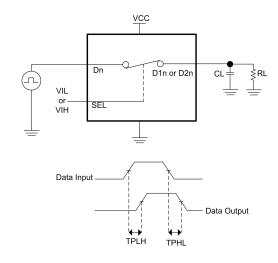
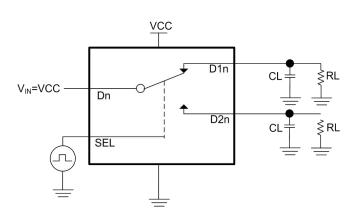


Figure 5: Propagation delay time



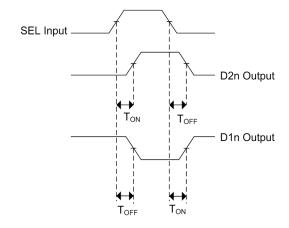
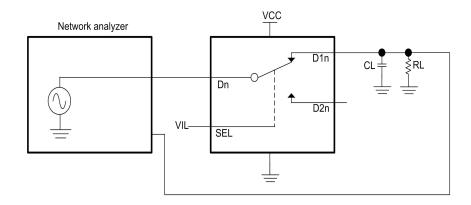


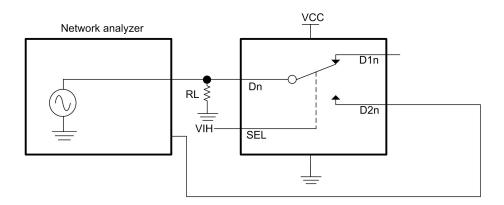
Figure 6: Select input to switch on/off time

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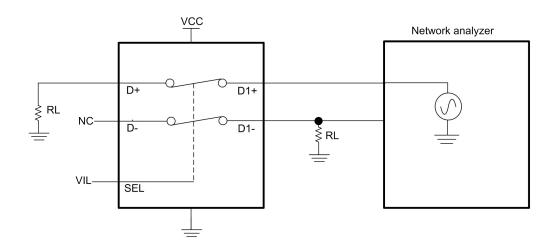




## Bandwidth (BW)



## Off isolation (OIRR)



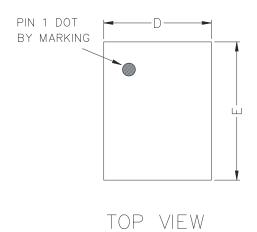
Crosstalk (Xtalk)

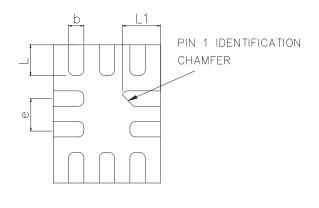
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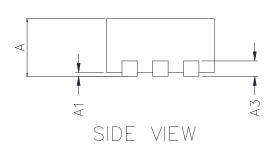
## **PACKAGE OUTLINE DIMENSIONS**

## QFN1418-10L





BOTTOM VIEW



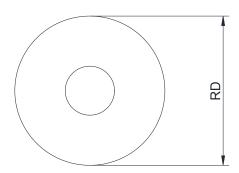
Symbol	Dimensions in Millimeters				
	Min.	Тур.	Max.		
А	0.50	0.50 0.55			
A1	0.00 - 0.05				
A3	0.15 Ref.				
D	1.35	1.45			
E	1.75 1.80		1.85		
b	0.15 0.20		0.25		
L	0.30 0.40 0.50				
L1	0.40 0.50 0.60		0.60		
е	0.40 BSC				

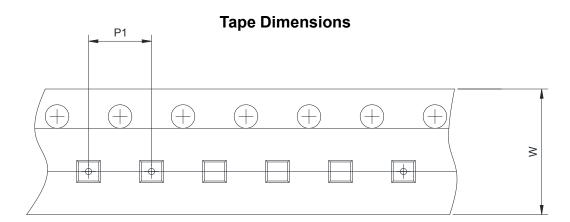
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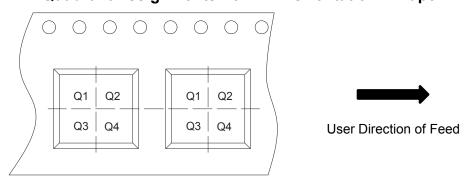
## TAPE AND REEL INFORMATION

#### **Reel Dimensions**





# **Quadrant Assignments For PIN1 Orientation In Tape**



RD	Reel Dimension	<b>▼</b> 7inch	13inch		
W	Overall width of the carrier tape	₹ 8mm	12mm		
P1	Pitch between successive cavity centers	2mm	<b>✓</b> 4mm	☐ 8mm	
Pin1	Pin1 Quadrant	<b>☑</b> Q1	□ Q2	□ Q3	□ Q4