

WS77481L-10/TR

4xSPST Antenna Tuning Switch

Descriptions

The WS77481L-10/TR is a 4 x single-pole, single-throw (4xSPST) switch designed for antenna tuning applications that require ultra-low ON resistance and low OFF capacitance. Switching is controlled by an integrated Mobile Industry Processor Interface (MIPI) controller.

No external DC blocking capacitors are required as long as no DC voltage is applied on any RF path.

The WS77481L-10/TR is provided in a compact LGA 10-pin, 1.5 x 1.1 x 0.53 mm (typical) that meets requirements for board-level assembly.

Features

- Broadband frequency range: 0.6 to 3.8 GHz
- Four RF shunts to ground:
 - Low R_{ON} : 1.0 Ω
 - Low C_{OFF} : 195 fF
- High peak RF operating voltage: 55V
- High isolation: +32 dB @ 2.7 GHz
- Supply voltage: 1.65 to 3.0 V
- Small LGA 10-pin, 1.5 x 1.1 x 0.53 mm

Applications

- Aperture tuning
- Impedance tuning
- Band switching

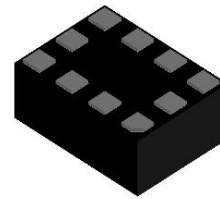


Figure1 LGA1511-10L(Bottom View)

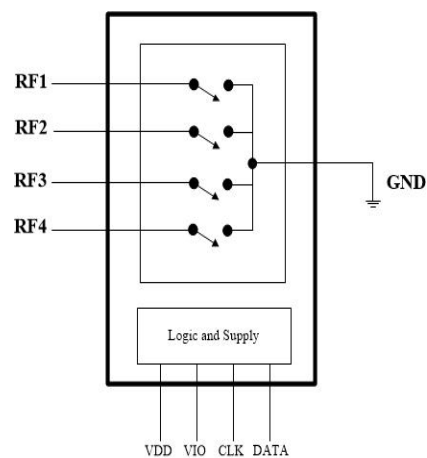
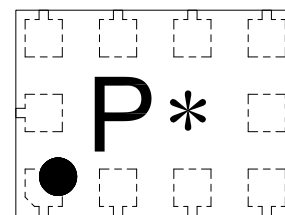


Figure2 Functional Block Diagram



P = Device code

* = Month code

Figure3 Marking(Top view)

Order information

Device	Package	Shipping
WS77481L-10/TR	LGA1511-10L	3000/Tape&Reel

Pin information

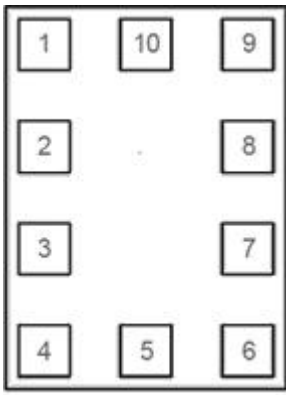
Pin	Function	Description	Transparent top view
1	DATA	MIPI data	
2	CLK	MIPI clock	
3	VDD	Supply voltage	
4	VIO	MIPI control voltage	
5	USID	USID select pin	
6	RF4	Single-ended RF port 4	
7	RF3	Single-ended RF port 3	
8	RF2	Single-ended RF port 2	
9	RF1	Single-ended RF port 1	
10	GND	Ground	

Figure4 Pin Information (Top view)

Application information

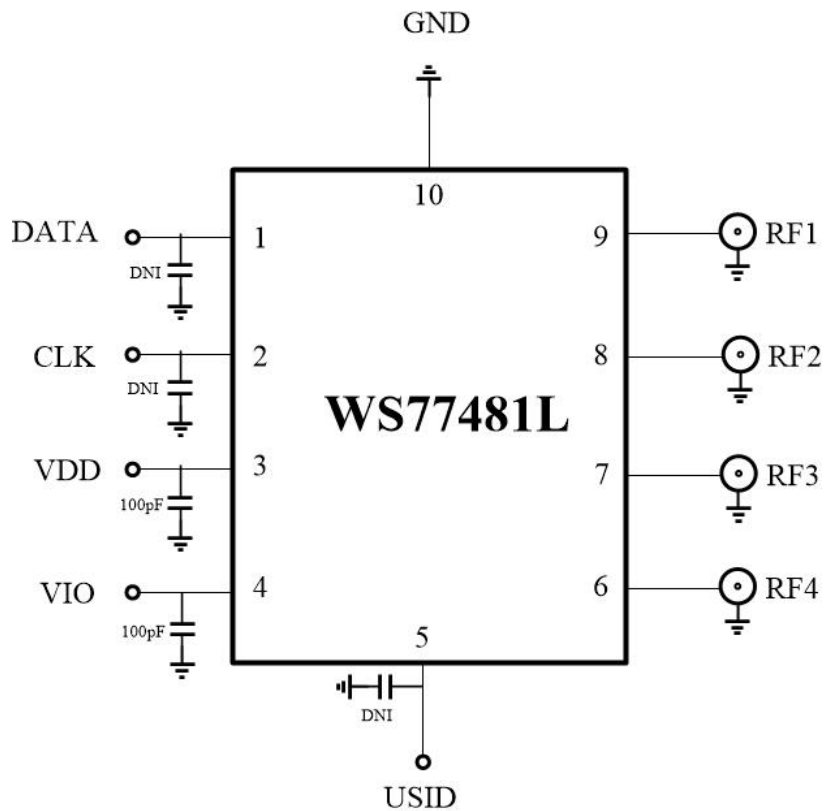


Figure5 Application Circuit

Recommended operating conditions
(VDD = 1.8 V, TOP = +25°C , Characteristic Impedance [Z0] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Supply voltage	VDD		1.65	1.8	3.0	V
Digital control voltage	VIO		1.65	1.8	1.95	V
Digital control signal voltage:						
Low	VCTL_LOW		0		0.2×VIO	V
High	VCTL_HIGH		0.8×VIO	1.8	VIO	V
Static VIO leakage current	IIO	VDD = 1.8 V, VIO = high		12		μA
Active supply current	IDD	VDD = 1.8 V, VIO = high, active		60		μA
Standby supply current	IDD	VDD = 1.8 V, VIO = high, standby		1		μA
RF path switching time	TSW	Measured from 50% of final control voltage to 90% of final RF amplitude		10		μs

Absolute maximum ratings¹

Parameter	Symbol	Condition	Min.	Max.	Units
Supply voltage	VDD	25°C	-0.3	+3.6	V
Digital control voltage	VIO	25°C	-0.3	+2.5	V
RF maximum voltage	VRF_MAX	Measured between RF ports to ground with shunt circuit configuration in 12.5% duty cycle RF power		55	V
Operating case temperature	Tc		-40	+90	°C
Storage temperature	TSTG		-55	+150	°C
Electrostatic Discharge	ESD	HBM	2000		V

¹ Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

Electrical Specifications¹
(V_{DD}= 1.8 V, T_{OP}=+25°C , Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Switch on resistance	RON	DC		1.0		Ω
Switch off capacitance	COFF	1.0 GHz		195		fF
Switch off resistance	ROFF	DC		370		kΩ
Isolation	ISO	700 - 960 MHz		49		dB
		960 - 2170 MHz		35		dB
		2170 - 2700 MHz		32		dB
		3300 - 3800 MHz		27		dB
Return Loss	RL	700 - 960 MHz		23		dB
		960 - 2170 MHz		21		dB
		2170 - 2700 MHz		20		dB
		3300 - 3800 MHz		16		dB
V _{peak} RF withstanding voltage ^{2,3}	V _{peak1}	12.5% duty cycle, switch OFF state, shunt configuration @ 50 Ω		55		V
V _{peak} RF withstanding voltage ^{2,4}	V _{peak2}	12.5% duty cycle, switch OFF state, shunt configuration @ 50 Ω		45		V
GSM LB harmonics	2f ₀ 3f ₀	0.824 to 0.915 GHz; Pin= +35dBm 2nd harmonics 3rd harmonics		-68		dBm
				-77		dBm
GSM HB harmonics	2f ₀ 3f ₀	1.710 to 1.910 GHz; Pin= +33dBm 2nd harmonics 3rd harmonics		-75		dBm
				-77		dBm
LTE LB harmonics	2f ₀ 3f ₀	0.824 to 0.960 GHz; Pin= +26dBm 2nd harmonics 3rd harmonics		-85		dBm
				-100		dBm
LTE MB harmonics	2f ₀ 3f ₀	1.710 to 2.200 GHz; Pin= +26dBm 2nd harmonics 3rd harmonics		-88		dBm
				-95		dBm
LTE HB harmonics	2f ₀ 3f ₀	2.300 to 2.690 GHz; Pin= +26dBm 2nd harmonics 3rd harmonics		-88		dBm
				-95		dBm
LTE UHB harmonics	2f ₀ 3f ₀	3.400 to 3.800 GHz; Pin= +26dBm 2nd harmonics 3rd harmonics		-88		dBm
				-95		dBm

¹ Performance is guaranteed only under the conditions listed in this table.

² The values are measured in a shunt configuration with the switch in an all ISOLATION state.

³ Defined at the RF input voltage at which either 2f₀ or 3f₀ harmonic reaches -33 dBm in a shunt configuration and all ISOLATION state with VSWR = 1.

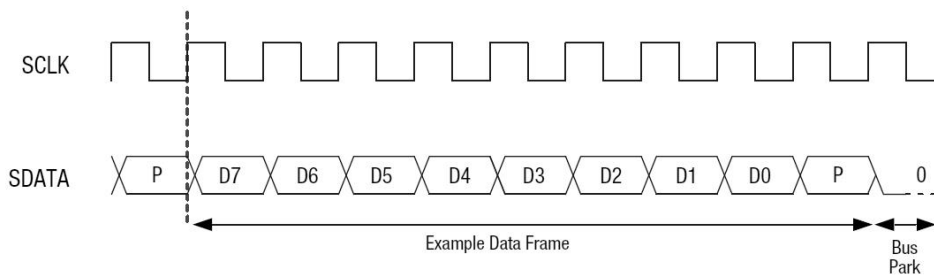
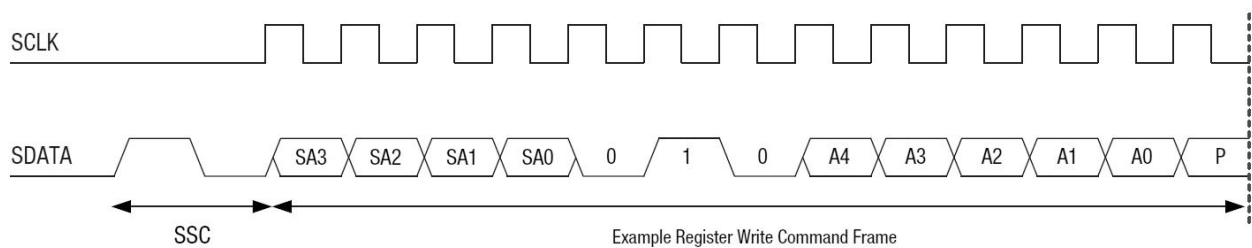
⁴ Defined at the RF input voltage at which either 2f₀ or 3f₀ harmonic reaches -40 dBm in a shunt configuration and all ISOLATION state with VSWR = 1.

Command Sequence Bit Definitions

Type	SSC	C11-C8	C7	C6-C5	C4	C3-C0	Parity Bits	BPC	Extended Operation					
									DA7(1)-DA0(1)	Parity Bits	BPC	DA7(n)-DA0(n)	Parity Bits	BPC
Reg0 Write	Y	SA[3:0]	1	Data[6:5]	Data[4]	Data[3:0]	Y	Y	-	-	-	-	-	-
Reg1 Write	Y	SA[3:0]	0	10	Addr[4]	Addr[3:0]	Y	-	Data[7:0]	-	-	-	Y	Y
Reg Read	Y	SA[3:0]	0	11	Addr[4]	Addr[3:0]	Y	Y	Data[7:0]	-	-	-	Y	Y

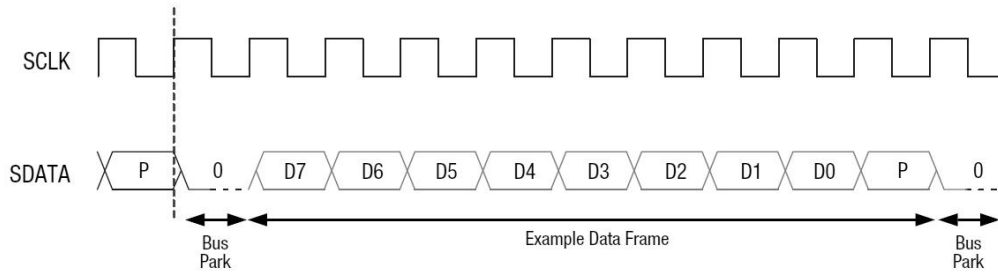
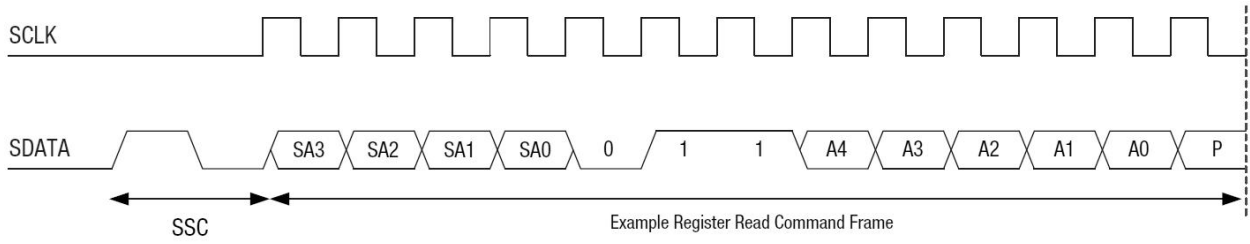
Legend:

SSC = Sequence start command DA = Data/address frame bits BC = Byte count (# of consecutive addresses)
 C = Command frame bits BPC = Bus park cyc



— Signal Driven by Master
 - - - Signal Not Driven; Pull-Down Only
 - - - For Reference Only

Register Write Command Timing Diagram



- Signal Driven by Master
- - - - Signal Not Driven; Pull-Down Only
- Signal Driven by Slave
- - - - For Reference Only

Register Read Command Timing Diagram

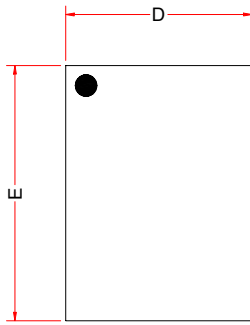
Truth Table for Operation

Register 0 (0x00)									
State	Mode	D7	D6	D5	D4	D3	D2	D1	D0
1	Isolation	x	x	x	x	0	0	0	0
2	RF1 to GND	x	x	x	x	0	0	0	1
3	RF2 to GND	x	x	x	x	0	0	1	0
4	RF3 to GND	x	x	x	x	0	1	0	0
5	RF4 to GND	x	x	x	x	1	0	0	0
6	RF1 and RF2 to GND	x	x	x	x	0	0	1	1
7	RF1 and RF3 to GND	x	x	x	x	0	1	0	1
8	RF1 and RF4 to GND	x	x	x	x	1	0	0	1
9	RF2 and RF3 to GND	x	x	x	x	0	1	1	0
10	RF2 and RF4 to GND	x	x	x	x	1	0	1	0
11	RF3 and RF4 to GND	x	x	x	x	1	1	0	0
12	RF1, RF2, and RF3 to GND	x	x	x	x	0	1	1	1
13	RF1, RF2, and RF4 to GND	x	x	x	x	1	0	1	1
14	RF1, RF3, and RF4 to GND	x	x	x	x	1	1	0	1
15	RF2, RF3, and RF4 to GND	x	x	x	x	1	1	1	0
16	RF1, RF2, RF3, and RF4 to GND	x	x	x	x	1	1	1	1

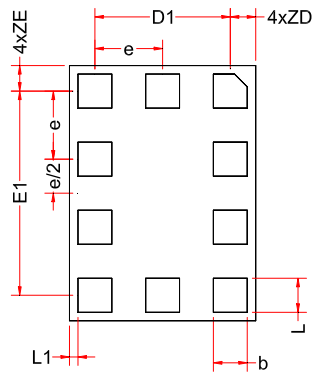
MIPI Register Map

Register Address	Register Name	Data Bit	Bit Name	Default	R/W	Description
0x00	STATE CONTROL	7:6	RESERVED	0X0	R/W	Reserved for future use
		5:4	RESERVED	0X0	R/W	Reserved for future use
		3:0	STATE CONTROL	0X0	R/W	Described in truth table
0x1C	PM_TRIGGER	7:6	PWR_MODE	0X0	R/W	Power Mode Control
		5	Trigger_Mask_2	0X0		If this bit is set to 1, trigger_2 is disabled
		4	Trigger_Mask_1	0X0		If this bit is set to 1, trigger_1 is disabled
		3	Trigger_Mask_0	0X0		If this bit is set to 1, trigger_0 is disabled
		2	Trigger_2	0X0		A write of 1 to this bit loads trigger_2's registers
		1	Trigger_1	0X0		A write of 1 to this bit loads trigger_1's registers
		0	Trigger_0	0X0		A write of 1 to this bit loads trigger_0's registers
0x1D	PRODUCT_ID	7:0	PRODUCT_ID[7:0]	0x52	R	Product Identification
0x1E	MANUFACTURER_ID	7:0	MANUFACTURER_ID[7:0]	0xBC	R	LSB Manufacturing Identification
0x1F	MAN_USID	7:6	RESERVED	0x0	R	Reserved for future use
		5:4	MANUFACTURER_ID[9:8]	0x3	R	MSB Manufacturing Identification
		3:0	USID[3:0]	0x6	R/W	User Identification, with pin 5 = grounded
				0x7	R/W	User Identification, with pin 5 = floating
0x9	R/W			User Identification, with pin 5 = tied to VIO		

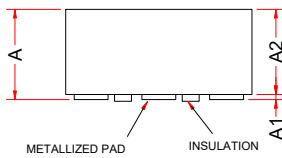
Package outline information



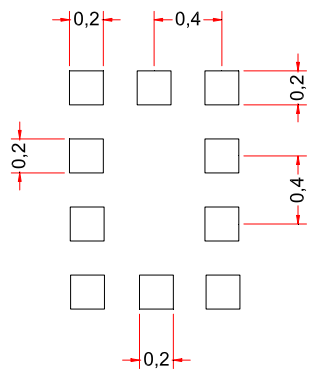
TOP VIEW



BOTTOM VIEW



SIDE VIEW

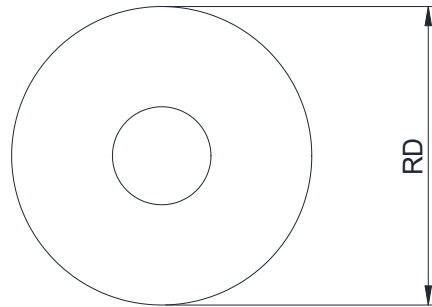


RECOMMENDED LAND PATTERN(unit:mm)

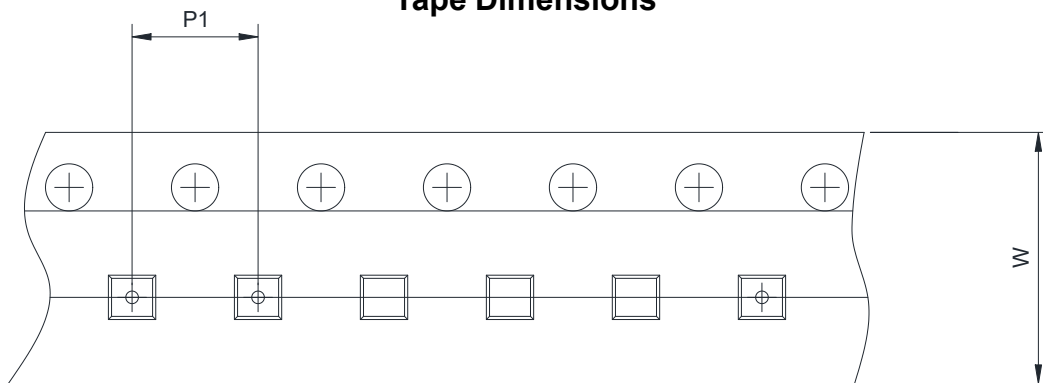
Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	0.47	0.53	0.59
A1	0.00	--	0.03
A2	--	--	0.56
b	0.15	0.20	0.25
L	0.15	0.20	0.25
D	1.05	1.10	1.15
E	1.45	1.50	1.55
D1	0.80 BSC		
E1	1.20 BSC		
ZD	0.15BSC		
ZE	0.15BSC		
e	0.40 BSC		
L1	0.00	0.05	0.10

Tape and Reel Information

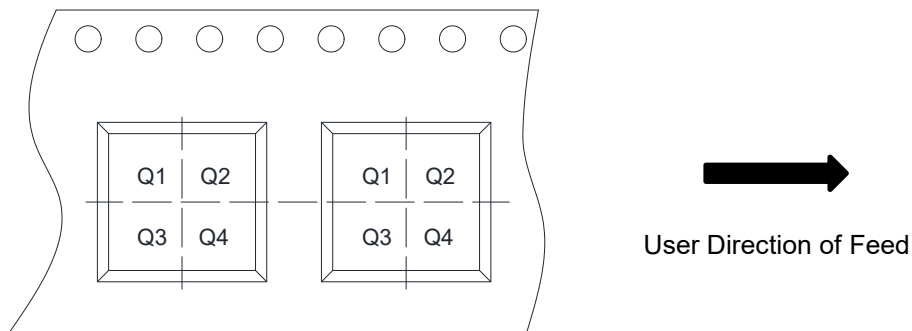
Reel Dimensions



Tape Dimensions



Quadrant Assignments For PIN1 Orientation In Tape



RD	Reel Dimension	<input checked="" type="checkbox"/> 7inch	<input type="checkbox"/> 13inch
W	Overall width of the carrier tape	<input checked="" type="checkbox"/> 8mm	<input type="checkbox"/> 12mm <input type="checkbox"/> 16mm
P1	Pitch between successive cavity centers	<input type="checkbox"/> 2mm	<input checked="" type="checkbox"/> 4mm <input type="checkbox"/> 8mm
Pin1	Pin1 Quadrant	<input checked="" type="checkbox"/> Q1	<input type="checkbox"/> Q2 <input type="checkbox"/> Q3 <input type="checkbox"/> Q4