TS5010

TeraTune™
Programmable Bandpass Filter

TERASYS TECHNOLOGIES
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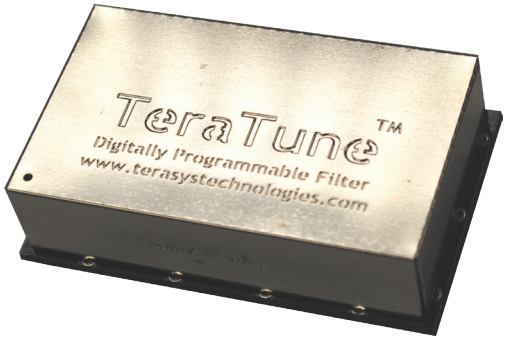
FEATURES

- 30 MHz to 90 MHz tunability
- 240 frequency steps
- Constant Q, two-pole Butterworth bandpass
- 1 W power handling
- 30 μs tuning speed
- Serial/parallel modes
- -40ºC to +85ºC



DESCRIPTION

The TS5010 series of TeraTune™ digitally programmable bandpass filters are available in various frequency ranges and bandwidths to help solve your co-site receiver problems. They feature 1 W power handling, low insertion loss, and frequency agility. The TS5010 is offered in both board-mounted and standalone SMA connectorized versions for ease of installation. The TS5010 offers performance upgrades in an industry standard footprint. Designed from the ground up, these filters present a cost-effective alternative with enhanced features.

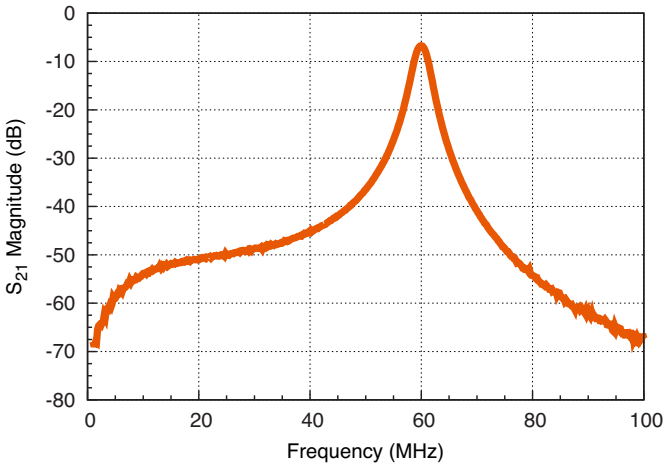


Fig. 1 : Typical measured response

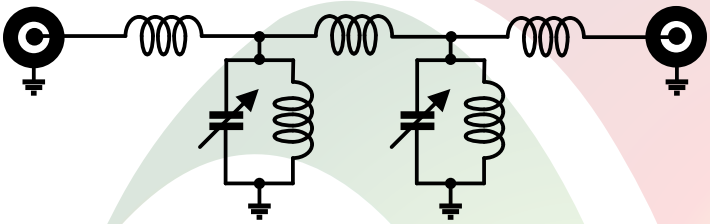


Fig. 2 : Equivalent circuit

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PART NUMBERING

TS	–	Series	–	Range	–	Steps	–	BW	–	Control	–	Options
TS	–	5010	-	30-90	-	240	-	5 4 3	-	P S R	-	C

P = Parallel, S = SPI, R = Asynchronous Serial (RS-232), C = Connectorized Package (SMA)

RF PERFORMANCE

Parameter	Sym	Min	Typ	Max	Units	Comments
Input Impedance	Z_0		50		Ω	
In-Band 3rd Order Intercept	*IP3*	40			dBm	
In-Band Power 5% Bandwidth 4% Bandwidth 3.3% Bandwidth	P_{IB}		 32 31 30		MHz	
Out-of-Band Power	P_{OB}	36			dBm	
Insertion Loss 5% Bandwidth 4% Bandwidth 3.3% Bandwidth	*IL*		 5 6 8	 6.5 7.5 9.5	dB	
Shape Factor (30 dB / 3 dB)	*SF*		6	7		
High Frequency Loss (2 x f_0) 5% Bandwidth 4% Bandwidth 3.3% Bandwidth	*HFL*	 60 65 70			dB	
Bandwidth Variation	*BWV*	-1	0	+1	%	
Centery Frequency Drift	f_D			100	ppm/C	

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POWER SUPPLY

Parameter	Sym	Min	Typ	Max	Units	Comments
Power Supply Voltage	V_{CC}	4.5	5.0	5.5	V	
Power Supply Current	I_{CC}	10		400	mA	
Bias Supply Voltage	V_{BB}	10		100	V	
Bias Supply Current	I_{BB}		4	5	mA	Quiescent

ENVIRONMENTAL

Parameter	Sym	Min	Typ	Max	Units	Comments
Operating Temperature	T_0	-40	25	85	°C	
Storage Temperature	T_S	-55		100	°C	
Relative Humidity	*RH*	0		95	%	

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CONTROL INPUTS

Parameter	Sym	Min	Typ	Max	Units	Comments
Input Low Voltage	V_{IL}	-0.3	0	0.3 V_{CC}	V	
Input High Voltage	I_{CC}	0.7 V_{CC}	V_{CC}	V_{CC} +0.3	mA	
Output Low Voltage	V_{OL}	0		0.3 V_{CC}	V	I = 10 mA
Output High Voltage	V_{OH}	0.7 V_{CC}		V_{CC}	mA	I = -10 mA

TuneCode

The frequency band is divided into equal steps with the TuneCode defined by the following formula. TuneCodes above 250 are reserved for special operations. Power save mode shuts off all PIN diodes for lowest power consumption.

$$\text{TuneCode} = \text{Steps} \times \left(\frac{f_{desired} - f_{min}}{f_{max} - f_{min}} \right)$$

Code	Operation
0 - 250	TuneCode
251	<reserved>
252	<reserved>
253	<reserved>
254	<reserved>
255	Power save mode

Parallel Mode

In parallel mode, the TuneCode is specified per the input pins when the /STB line goes low. Once strobed, an internal processor looks up the required PIN diode control words and sets them accordingly. The PIN diode switch drivers take another ten microseconds to slew on or off, and the resulting bandpass is indeterminate during this time.

Parameter	Sym	Min	Typ	Max	Units	Comments
Setup Time	t_S	0			ns	
Hold Time	t_H	100			ns	
Strobe Pulse Width	t_W	25			ns	
Acces time from Strobe to +10 dBm	t_{ACC}			30	µs	
Dwell Time	t_{DW}	250			µs	

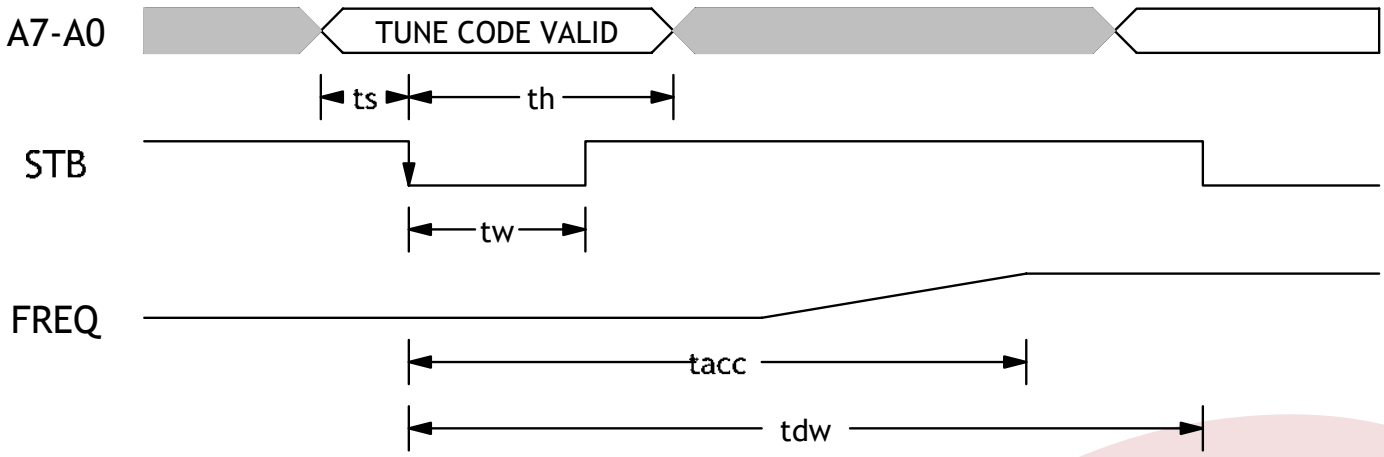

Fig. 3 : Parallel mode timing

Serial (SPI) Mode

The TuneCode is clocked in serially one bit at a time, MSB first. Timing is synchronous and can be at any rate under the maximum clock rate of 5 MHz. To start a sequence, the chip select line (/SS) is pulled low. Once /SS goes high, the internal processor begins the decoding process and sets the new frequency.

Parameter	Sym	Min	Typ	Max	Units	Comments
Select Setup Time	t_{CS}	100			ns	
Data Setup Time	t_{DS}	50			ns	
Data Hold Time	t_{DH}	50			ns	
Clock High Time	t_{CH}	100			ns	
Clock Low Time	t_{CL}	100			ns	
Acces time from Strobe to +10 dBm	t_{ACC}			30	µs	
Dwell Time	t_{DW}	250			µs	

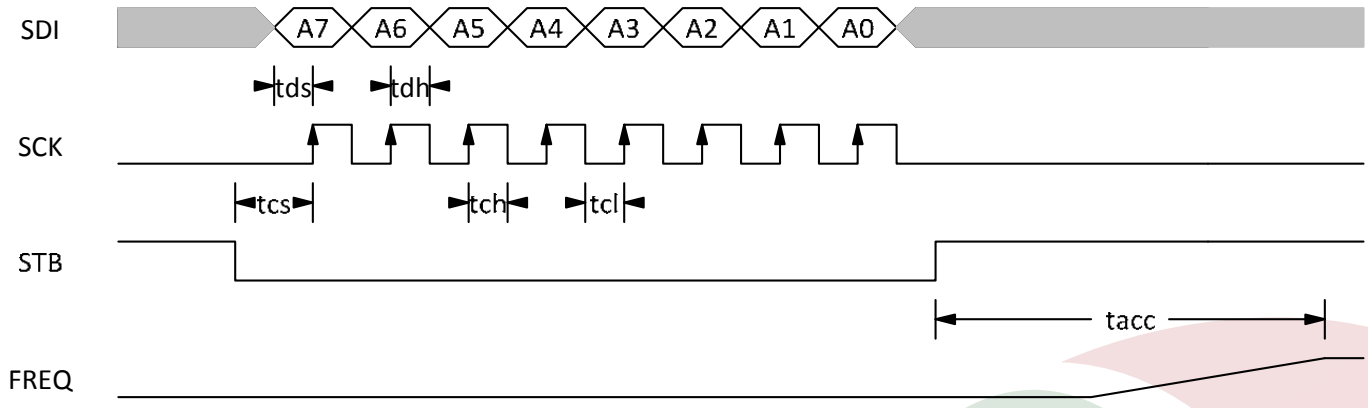

Fig. 4 : Serial mode timing

RS-232 (ASYNC) Mode

The baud rate is fixed at 9600, 8N1. Voltage levels are TTL, with mark high, space low. Be careful not to use TuneCodes 253 and 254 as they are reserved for manufacturing and calibration purposes. Use of these codes may cause indeterminate results.

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PINOUTS

Pin	Name	Type	Description	Pin*
1	RF_IN	I/O	RF Input and Output	
2	GND		Ground	
3	GND		Ground	
4	VCC	I	+5 V Supply	1
5	GND		Ground	2
6	A7	I	Tune Bit 7 (MSB)	3
7	A6	I	Tune Bit 6	4
8	A5	I	Tune Bit 5	5
9	A4 RX	I	Tune Bit 4 Receive RS-232 (Logic Levels)	6
10	A3 TX	I/O	Tune Bit 3 Receive RS-232 (Logic Levels)	7
11	A2 SDO	I/O	Tune Bit 2 Synchronous Data Out (SPI)	8
12	A1 SDI	I	Tune Bit 1 Synchronous Data In (SPI)	9
13	A0 SCK	I	Tune Bit 0 Synchronous Clock (SPI)	10
14	/STB /S5	I	Strobe (Parallel Load) Synchronous Select (SPI)	11
15	GND		Ground	12
16	GND		Ground	13
17	VBB	I	+100 V Bias Supply	14
18	GND		Ground	15
19	GND		Ground	
20	GND		Ground	
21	RF_OUT	I/O	RF Input and Output	
22	GND		Ground	
23 - 41	NC		No Connect	
42	GND		Ground	

* SMA version

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MECHANICAL

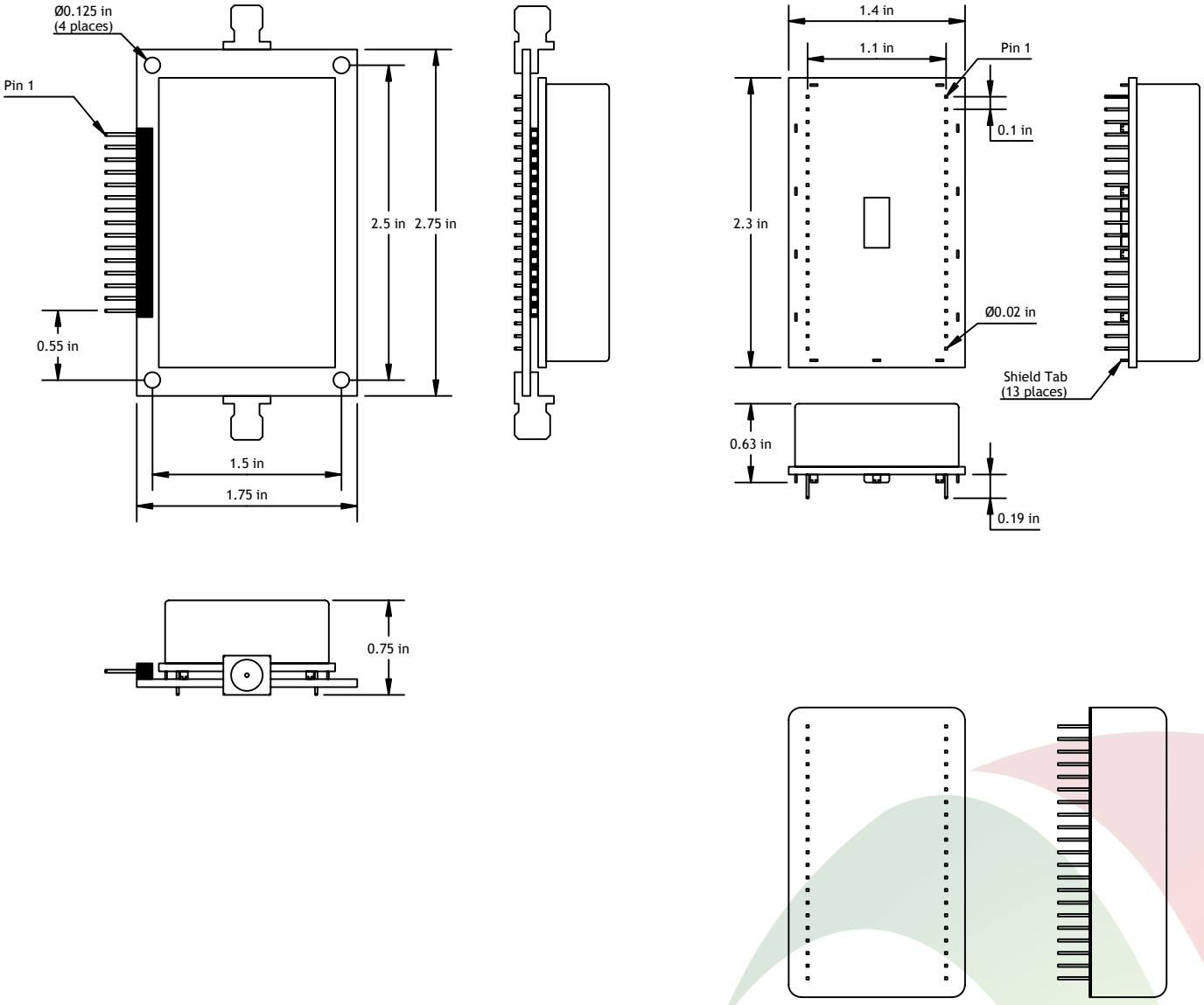

Fig. 5 : (left) Connectorized SMA package, (right) Board-mount package

APPLICATION INFORMATION

The power handling capability of the filter is dependent on VSWR, bandwidth, and bias voltage. Lower levels of bias voltage, all the way down to +10 V are possible, as long as RF signal levels remain appropriately low. Power levels should be reduced to below 0 dBm during switching.

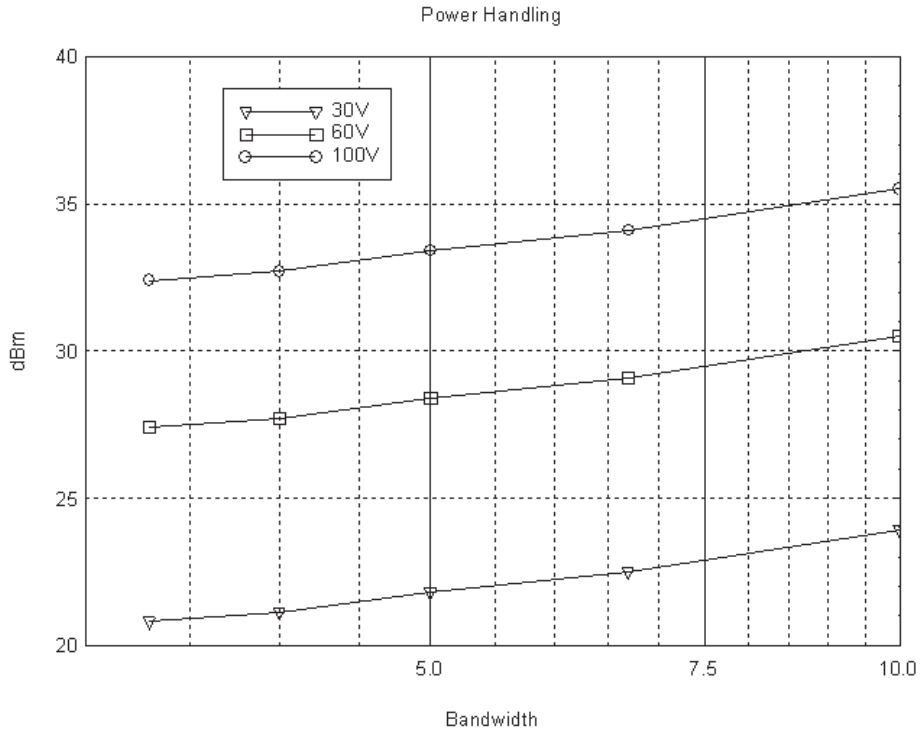

Fig. 6 : Power handling versus bias and bandwidth

Soldering

The TS5010 should be hand soldered. Wave solder or IR reflow may cause parts on the internal circuit boards to loosen or shift position. The use of sockets is acceptable.

NC Pins

Do not connect anything to the NC (no connect) pints. They are used for internal signaling (PIN diode drive voltages).

Soldering

The edges of the bottom circuit board have exposed inner layer traces (GND, VCC). Care must be taken such that they do not short to adjacent components.