

Contents

1	Introduction	1
1.1	Motivation	1
1.2	Harmonic formation in TWTs	4
1.3	Specification of design goals	7
1.4	Structure of this dissertation	9
2	Suppression of the harmonic	11
2.1	State of technology	11
2.1.1	Operation in back-off	11
2.1.2	Tapering of the helix pitch	12
2.1.3	Harmonic injection into a 500 W S-band TWT	15
2.2	Filter helix	21
2.2.1	Filter helix concept	21
2.2.2	Harmonic suppression with filter helices	23
2.2.3	Design parameters of filter helices	26
2.3	Simulation	29
2.3.1	Interaction simulation with MVTRAD	29
2.3.2	The MVTRAD extension “Reflections”	32
2.3.3	Filter-helix modeling	34
3	Filter-helix implementation in L-band	40
3.1	Transmission-line tester	40

3.2	L-band TWT	43
3.2.1	Tube without filter helix	43
3.2.2	Filter optimization in L-band	45
3.2.3	Measurement results	50
4	Filter implementation in S-band TWTs	55
4.1	First S-band design	55
4.1.1	Filter design	57
4.1.2	Measurements	59
4.2	Variation of period in a filter helix TWT delay line	68
4.2.1	Filter length	68
4.2.2	Filter period	70
4.2.3	Variation of period along the filter	72
4.3	New S-band TWT	76
4.3.1	Taper design	76
4.3.2	Filter optimization	78
4.3.3	Measurement with Taper B	85
4.3.4	Reflection at the output coupler	88
5	Summary	91
	List of Figures	95
	List of Abbreviations	100
	Bibliography	102