

# Table of Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Typography	1
1.2	Historical Remarks and Motivation	2
1.3	Advanced Computer Arithmetic	4
1.4	Connection with Programming Languages	7
1.5	Survey of PASCAL-XSC	8
1.5.1	Universal Operator Concept and Arbitrary Result Type	9
1.5.2	Overloading of Procedures, Functions, and Operators	11
1.5.3	Module Concept	11
1.5.4	Dynamic Arrays and Subarrays	12
1.5.5	String Concept	14
1.5.6	Arithmetic and Rounding	14
1.5.7	Accurate Expressions	14
<b>2</b>	<b>Language Reference</b>	<b>15</b>
2.1	Basic Symbols	17
2.2	Identifiers	18
2.3	Constants, Types, and Variables	20
2.3.1	Simple Types	21
2.3.2	Structured Types	25
2.3.2.1	Arrays	25
2.3.2.2	Subarrays	27
2.3.2.3	Access to Index Bounds	28
2.3.2.4	Dynamic Arrays	28
2.3.2.5	Strings	30
2.3.2.6	Dynamic Strings	30
2.3.2.7	Records	31
2.3.2.8	Records with Variants	32
2.3.2.9	Sets	33
2.3.2.10	Files	34
2.3.2.11	Text Files	35
2.3.3	Structured Arithmetic Standard Types	36
2.3.3.1	The Type <i>complex</i>	36
2.3.3.2	The Type <i>interval</i>	37
2.3.3.3	The Type <i>cinterval</i>	37
2.3.3.4	Vector Types and Matrix Types	38
2.3.4	Pointers	38

2.3.5	Compatibility of Types . . . . .	40
2.3.5.1	Compatibility of Array Types . . . . .	41
2.3.5.2	Compatibility of Strings . . . . .	43
2.4	Expressions . . . . .	44
2.4.1	Standard Expressions . . . . .	44
2.4.1.1	Integer Expressions . . . . .	46
2.4.1.2	Real Expressions . . . . .	47
2.4.1.3	Boolean Expressions . . . . .	51
2.4.1.4	Character Expressions . . . . .	52
2.4.1.5	Enumeration Expressions . . . . .	53
2.4.2	Accurate Expressions ( <b>#</b> -Expressions) . . . . .	54
2.4.3	Expressions for Structured Types and Pointer Expressions . . . . .	57
2.4.3.1	Array Expressions . . . . .	57
2.4.3.2	String Expressions . . . . .	58
2.4.3.3	Record Expressions . . . . .	59
2.4.3.4	Set Expressions . . . . .	59
2.4.3.5	Pointer Expressions . . . . .	60
2.4.4	Extended Accurate Expressions ( <b>#</b> -Expressions) . . . . .	60
2.4.4.1	<b>#</b> -Expressions for the Arithmetic Types . . . . .	61
2.4.4.2	<b>#</b> -Expressions for Vectors . . . . .	63
2.4.4.3	<b>#</b> -Expressions for Matrices . . . . .	64
2.4.4.4	List of the Operands in <b>#</b> -Expressions . . . . .	66
2.4.4.5	Review of General <b>#</b> -Expressions . . . . .	69
2.5	Statements . . . . .	71
2.5.1	Assignment Statement . . . . .	71
2.5.2	Input/Output Statements . . . . .	72
2.5.3	Empty Statement . . . . .	76
2.5.4	Procedure Statement . . . . .	76
2.5.5	<b>goto</b> -Statement . . . . .	77
2.5.6	Compound Statement . . . . .	78
2.5.7	Conditional Statements . . . . .	78
2.5.7.1	<b>if</b> -Statement . . . . .	78
2.5.7.2	<b>case</b> -Statement . . . . .	78
2.5.8	Repetitive Statements . . . . .	79
2.5.8.1	<b>while</b> -Statement . . . . .	79
2.5.8.2	<b>repeat</b> -Statement . . . . .	80
2.5.8.3	<b>for</b> -Statement . . . . .	80
2.5.9	<b>with</b> -Statement . . . . .	81
2.6	Program Structure . . . . .	83
2.7	Subroutines . . . . .	85
2.7.1	Procedures . . . . .	85
2.7.2	List of Predefined Procedures and Input/Output Statements . . . . .	88
2.7.3	Functions . . . . .	89
2.7.4	Functions with Arbitrary Result Type . . . . .	90
2.7.5	List of Predefined Functions . . . . .	91

2.7.6	Operators . . . . .	93
2.7.7	Table of Predefined Operators . . . . .	97
2.7.8	<b>forward-</b> and <b>external-</b> Declaration . . . . .	98
2.7.9	Modified Call by Reference for Structured Types . . . . .	98
2.7.10	Overloading of Procedures, Functions, and Operators . . . . .	100
2.7.11	Overloading of <i>read</i> and <i>write</i> . . . . .	102
2.7.12	Overloading of the Assignment Operator := . . . . .	105
2.8	Modules . . . . .	107
2.9	String Handling and Text Processing . . . . .	111
2.9.1	Input of Characters and Strings . . . . .	115
2.10	How to Use Dynamic Arrays . . . . .	120
<b>3</b>	<b>The Arithmetic Modules . . . . .</b>	<b>125</b>
3.1	The Module C_ARI . . . . .	131
3.2	The Module L_ARI . . . . .	135
3.3	The Module CL_ARI . . . . .	140
3.4	The Module MV_ARI . . . . .	146
3.5	The Module MVC_ARI . . . . .	151
3.6	The Module MVL_ARI . . . . .	156
3.7	The Module MVCL_ARI . . . . .	162
3.8	The Hierarchy of the Arithmetic Modules . . . . .	171
3.9	A Complete Sample Program . . . . .	172
<b>4</b>	<b>Problem-Solving Routines . . . . .</b>	<b>179</b>
<b>5</b>	<b>Exercises with Solutions . . . . .</b>	<b>183</b>
5.1	Test of Representability . . . . .	184
5.2	Summation of Exponential Series . . . . .	186
5.3	Influence of Rounding Errors . . . . .	188
5.4	Scalar Product . . . . .	190
5.5	Boothroyd/Dekker Matrices . . . . .	192
5.6	Complex Functions . . . . .	194
5.7	Surface Area of a Parallelepiped . . . . .	197
5.8	Parallelism and Intersection of Lines . . . . .	200
5.9	Transposed Matrix, Symmetry . . . . .	203
5.10	Rail Route Map . . . . .	206
5.11	Inventory Lists . . . . .	209
5.12	Complex Numbers and Polar Representation . . . . .	212
5.13	Complex Division . . . . .	215
5.14	Electric Circuit . . . . .	217
5.15	Alternating Current Measuring Bridge . . . . .	221
5.16	Optical Lens . . . . .	224
5.17	Interval Evaluation of a Polynomial . . . . .	227
5.18	Calculations for Interval Matrices . . . . .	230
5.19	Differentiation Arithmetic . . . . .	233
5.20	Newton's Method with Automatic Differentiation . . . . .	237

5.21	Measurement of Time . . . . .	239
5.22	Iterative Method . . . . .	241
5.23	Trace of a Product Matrix . . . . .	245
5.24	Calculator for Polynomials . . . . .	248
5.25	Interval Newton Method . . . . .	253
5.26	Runge-Kutta Method . . . . .	255
5.27	Rational Arithmetic . . . . .	258
5.28	Evaluation of Polynomials . . . . .	263
<b>A</b>	<b>Syntax Diagrams . . . . .</b>	<b>269</b>
<b>B</b>	<b>Indices and Lists . . . . .</b>	<b>297</b>
B.1	Syntax Diagrams . . . . .	297
B.2	Reserved Words . . . . .	299
B.3	Predefined Identifiers . . . . .	300
B.4	Operators . . . . .	302
B.4.1	Basic Operators . . . . .	302
B.4.2	Arithmetic Operators . . . . .	303
B.4.3	Relational Operators for the Arithmetic Types . . . . .	304
B.4.4	Assignment Operators . . . . .	305
B.5	Predefined Functions . . . . .	307
B.6	Transfer Functions . . . . .	320
B.7	Predefined Procedures . . . . .	323
B.8	#-Expressions . . . . .	328
B.8.1	Real and Complex #-Expressions . . . . .	328
B.8.2	Real and Complex Interval #-Expressions . . . . .	329
	<b>Bibliography . . . . .</b>	<b>331</b>
	<b>Index . . . . .</b>	<b>335</b>