

# Contents

Preface — V

Acknowledgments — VII

Acronyms — XIII

<b>1</b>	<b>Introduction and preview — 1</b>
1.1	Introduction — 1
1.2	Design technologies of system-level EMC engineering — 2
1.2.1	Application demands of system-level EMC technology engineering — 2
1.2.2	Research focus of design technology of system-level EMC engineering — 6
1.3	Design flow of system-level EMC engineering — 24
1.4	Standards related to system-level EMC engineering design — 24
	References — 35
<b>2</b>	<b>Theory of system-level EMC — 37</b>
2.1	Basic concept — 37
2.2	Electromagnetic interference sources — 41
2.2.1	Conditions of EMI — 41
2.2.2	Types of EMI sources — 42
2.3	Theory of transmission and coupling of EM energy — 42
2.3.1	Path of EMI coupling — 44
2.3.2	Basic theory of conduction coupling — 45
2.3.3	Basic theory of radiation coupling — 50
2.4	Characteristic of EM sensitive sources — 60
2.4.1	Channel model of receivers — 60
2.4.2	Blockage, crossover distortion, and intermodulation of receiver — 61
2.5	Examples of application of EMC theory — 62
	References — 65
<b>3</b>	<b>Engineering design of system-level EMC — 67</b>
3.1	Design method — 67
3.2	Design principles — 68
3.3	Design flow — 69
3.3.1	Confirmation of boundary condition — 70
3.3.2	Predictive analysis — 71
3.3.3	Multilevel design — 72

- 3.4 Content of design — **72**
- 3.4.1 Design of controlling the EM emission and sensitivity of equipment/subsystem — **74**
- 3.4.2 Design of controlling interantenna interference — **96**
- 3.4.3 Design of controlling intercable interference — **99**
- 3.4.4 Design of EM radiation protection — **108**
- 3.4.5 Design of lapping and grounding — **124**
- 3.4.6 Design of lightning protection — **133**
- 3.4.7 Design of electrostatic protection — **136**
- 3.4.8 Design of power supply — **139**
- 3.5 Examples of engineering design — **142**
- References — **145**
  
- 4 Theory and method of system-level EM simulation — 147**
- 4.1 EM simulation methods — **147**
- 4.1.1 Method of moments — **150**
- 4.1.2 Finite-difference time-domain method — **157**
- 4.1.3 High-frequency algorithms — **165**
- 4.1.4 High-low-frequency hybrid algorithms — **173**
- 4.1.5 Parallel computing for EM simulation — **177**
- 4.2 Examples of airborne antenna system-level EMC simulation — **185**
- 4.2.1 Radiation and coupling of airborne monopole antennas — **185**
- 4.2.2 Radiation of airborne microstrip-phased array antennas — **187**
- 4.2.3 Radiation of slotted waveguide-phased array antenna above a metal slab — **200**
- 4.2.4 Radiation of the airborne-slotted waveguide-phased array antenna — **204**
- References — **214**
  
- 5 Analysis of system-level EMC prediction — 217**
- 5.1 Theory of system-level EMC prediction — **217**
- 5.1.1 Equation of system-level EMC prediction — **217**
- 5.1.2 Transmitter model — **218**
- 5.1.3 Receiver model — **223**
- 5.1.4 Antenna model — **226**
- 5.1.5 Propagation model — **232**
- 5.2 Strategy of system-level EMC prediction — **238**
- 5.2.1 Step of system-level EMC prediction — **238**
- 5.2.2 Method of system-level EMC prediction — **239**
- 5.3 Introduction of EMC prediction software — **246**
- 5.3.1 Domestic and international EMC prediction software — **246**

- 5.3.2 EMC software for airborne platform — 248
- 5.4 Examples of System-level EMC prediction — 252
  - References — 258
- 6 Experiment and assessment of system-level EMC — 259**
  - 6.1 EMC tests and experiment system frame — 259
  - 6.2 System-level EMC tests and experiment contents — 259
    - 6.2.1 Equipment-level/LRU-level EMC experiment — 261
    - 6.2.2 Subsystem/rack-level EMC experiment — 261
    - 6.2.3 Whole-system EMC experiment — 265
    - 6.2.4 Verification tests of EM environment adaptability — 269
    - 6.2.5 Test results and report details of system-level EMC experiment — 270
  - 6.3 Experimental facility and test field of EMC — 271
    - 6.3.1 Open area test site — 271
    - 6.3.2 Semianechoic chamber — 272
    - 6.3.3 Reverberation chamber — 273
    - 6.3.4 TEM chamber — 276
    - 6.3.5 GTEM chamber — 276
    - 6.3.6 Shielded room — 278
  - 6.4 Evaluation method of system-level EMC experiment — 278
    - 6.4.1 Experiment method of EMI emission and EMS — 278
    - 6.4.2 Experiment method of system-level EMC — 287
    - 6.4.3 Evaluation method of system-level EMC — 297
  - 6.5 Typical evaluation platform for EMC experiment and examples of their application — 300
    - 6.5.1 Equipment-level and subsystem-level EMC verification system — 300
    - 6.5.2 Monitoring system of EM environment and EM spectrum — 303
    - 6.5.3 System of HPM excitation for EM environment — 306
    - 6.5.4 Verification and evaluation system for EM environmental effects — 311
      - References — 318
- 7 Stage control of system-level EMC — 319**
  - 7.1 Stage control technology of spatial EMC — 322
    - 7.1.1 Basic concept of spatial EMC control — 322
    - 7.1.2 Design flow of spatial EMC control — 325
  - 7.2 Stage control technology of frequency-domain EMC — 328
    - 7.2.1 Basic concept of frequency-domain distribution — 329
    - 7.2.2 Design flow of frequency management — 331
  - 7.3 Stage control technology of energy-domain EMC — 336

- 7.3.1 Basic concept of filtering — **336**
- 7.3.2 Design flow of filtering — **337**
- 7.4 Stage control technology of time-domain EMC — **338**
- 7.4.1 Basic concept of time-domain EMC control — **338**
- 7.4.2 Design flow of time-domain EMC control — **339**
- 7.5 Application examples of system-level EMC control — **340**
- 7.5.1 Establish a mathematical model of the problem — **341**
- 7.5.2 Select an algorithm — **342**
- References — **346**

**8 Applications in engineering projects and progress in new technologies — 347**

- 8.1 Design of system-level EMC — **347**
- 8.1.1 Basic status of system-level EMC environment — **348**
- 8.1.2 Design of system-level EM environment — **348**
- 8.2 Simulation of EMC prediction — **351**
- 8.2.1 Analysis of EMC prediction — **351**
- 8.2.2 Simulation of EMC prediction — **351**
- 8.3 System-level EMC test — **352**
- 8.3.1 Equipment-level/subsystem-level EMC test — **352**
- 8.3.2 System-level EMC test — **354**
- 8.4 System-level EMC control — **357**
- 8.4.1 Design control — **357**
- 8.4.2 Test control — **359**
- 8.5 System-level EMC evaluation — **360**
- 8.6 EMC new technologies and progress — **361**
- 8.6.1 Comprehensive design technology — **362**
- 8.6.2 New simulation prediction technology — **366**
- 8.6.3 New technology of measurement — **367**
- 8.6.4 New technology of EM spectrum control — **370**
- References — **374**

**Index — 375**