INTERNATIONAL STANDARD

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AMENDMENT 1
2006-06-15

Information technology — Radio frequency identification for item management —

Part 6: Parameters for air interface communications at 860 MHz to 960 MHz

AMENDMENT 1: Extension with Type C and update of Types A and B

Technologies de l'information — Identification par radiofréquence (RFID) pour la gestion d'objets —

Partie 6: Paramètres de communications d'une interface d'air entre 860 MHz et 960 MHz

AMENDEMENT 1: Extension avec Type C et mise à jour des Types A et B

Reference number
ISO/IEC 18000-6:2004/Amd.1:2006(E)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Amendment 1 to ISO/IEC 18000-6:2004 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

Amendment 1 to ISO/IEC 18000-6:2004 covers the extension of ISO/IEC 18000-6 to Type C, to accommodate the latest development of passive RFID technology in the UHF frequency band from 860 MHz to 960 MHz.

Furthermore, it covers changes in order to achieve an improved collision arbitration and a more robust protocol for Type A.

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AMENDMENT 1: Extension with Type C and update of Types A and B

Page vii, Introduction

Replace the paragraph after the bulleted list with the following paragraphs:

This International Standard specifies the physical and logical requirements for a passive-backscatter, interrogator-talks-first (ITF), radio frequency identification (RFID) system operating in the 860 MHz to 960 MHz frequency range. The system comprises interrogators, also known as readers, and tags, also known as labels.

An interrogator transmits information to a tag by modulating an RF signal in the 860 MHz to 960 MHz frequency range. The tag receives both information and operating energy from this RF signal. Tags are passive, meaning that they receive all of their operating energy from the interrogator's RF waveform.

An interrogator receives information from a tag by transmitting a continuous-wave (CW) RF signal to the tag; the tag responds by modulating the reflection coefficient of its antenna, thereby backscattering an information signal to the interrogator. The system is ITF, meaning that a tag modulates its antenna reflection coefficient with an information signal only after being directed to do so by an interrogator.

Interrogators and tags are not required to talk simultaneously; rather, communications are half-duplex, meaning that interrogators talk and tags listen, or vice versa.

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Page vii, Introduction

Add the following to the table of patent holders:

Contact details	Patent number	Affected clause(s) in this part of ISO/IEC 18000
Alien Technology Corporation ATTN: Dr. John Stephen Smith 18200 Butterfield Blvd Morgan Hill CA 95037 USA Tel: 1-408-782-3900 Fax: 1-408-782-3910 E-mail: ssmith@alientechnology.com	6,933,848 USA, 10/141,489 USA, 11/029,445 USA, 2003/0019929 USA, 10/160,458 USA, 11/132,085 USA, 11/153,030 USA, (divisional of 6,942,155 US), Not yet assigned, (continuation of 11/153,030 USA), 2005/0114326 USA, 10/982,557 USA, Not yet assigned, (continuation of 10/982,557 USA), Not yet assigned, (continuation of 10/982,557 USA), US04/036991 PCT, WO2005048180, 2003/0137403 USA, 10/267,924 USA, WO03032240, 2820082.9 China, 1636039A China, 2801064.3 EU, 2003-535135 Japan, 091123291 Taiwan, 60/681,656 USA, 10/915,725 USA, US04/025883 PCT, 10/140,557 US,	9.3.2.1.1.1, 9.3.2.1.2.1, 9.3.2.4.7, 9.3.2.10.3.4, Fig. Amd.1-22, Fig. Amd.1-26, 9.3.2.1.1.1, 9.3.2.1.2.1, 9.3.2.4.7, 9.3.2.10.3.4, Fig. Amd.1-22, Fig. Amd.1-26, 9.3.2.7, 9.3.2.10.1.1, 9.3.2.10.2.4, Table Amd.1-28, 9.3.2.7, 9.3.2.10.1.1, 9.3.2.10.2.4, Table Amd.1-28, 9.3.2.1.1.1, 9.3.2.1.2.1, 9.3.2.2, 9.3.2.3, 9.3.2.4.7, 9.3.2.10.3.4, Table Amd.1-16, Fig. Amd.1-22, Fig. Amd.1-26, 9.3.2.1.1.1, 9.3.2.1.2.1, 9.3.2.2, 9.3.2.3, 9.3.2.4.7, 9.3.2.10.3.4, Table Amd.1-16, Fig. Amd.1-22, Fig. Amd.1-26, 9.3.2.2, 9.3.2.3, 9.3.2.4, 9.3.2.4.1, 9.3.2.4.2, 9.3.2.4.8, 9.3.2.5, 9.3.2.8, 9.3.2.9, 9.3.2.10, 9.3.2.10.1.1, 9.3.2.10.2.1, 9.3.2.10.2.2, 9.3.2.10.2.3, 9.3.2.10.2.4, Table Amd.1-18, Table Amd.1-19, Table Amd.1-20, Fig. Amd.1-21, Fig. Amd.1-22, 9.3.2.10, Table Amd.1-18, 9.3.2.9, Fig. Amd.1-22, 9.3.2.2, 9.3.2.3, 9.3.2.4, 9.3.2.4.1, 9.3.2.4.2, 9.3.2.4.8, 9.3.2.5, 9.3.2.8, 9.3.2.9, 9.3.2.10.1.1, 9.3.2.10.2.1, 9.3.2.10.2.2, 9.3.2.10.2.3, 9.3.2.10.2.4, Table Amd.1-18, Table Amd.1-19, Table Amd.1-20, Fig. Amd.1-21, Fig. Amd.1-22, 9.3.2.1.1.1, 9.3.2.1.2.1, 9.3.2.4.7, 9.3.2.10.1.1, 9.3.2.10.2.4, 9.3.2.10.3.4, 9.3.2.10.3.5, Table Amd.1-39, Fig. Amd.1-22, Fig. Amd.1-26, Fig. Amd.1-27, 9.3.2.1.1.1, 9.3.2.1.2.1, 9.3.2.4.7, 9.3.2.10.1.1, 9.3.2.10.2.4, 9.3.2.10.3.4, 9.3.2.10.3.5, Table Amd.1-39, Fig. Amd.1-22, Fig. Amd.1-26, Fig. Amd.1-27, 9.3.2.1.1.1, 9.3.2.1.2.1, 9.3.2.4.7, 9.3.2.10.1.1, 9.3.2.10.2.4, 9.3.2.10.3.4, 9.3.2.10.3.5, Table Amd.1-39, Fig. Amd.1-22, Fig. Amd.1-26, Fig. Amd.1-27, 9.3.2.10.1.1, 9.3.2.10.2.4, 9.3.1.3.2.3, 9.3.1.3.3, Table Amd.1-12, Fig. Amd.1-15, Fig. Amd.1-16, 9.3.2.2, 9.3.2.3, 9.3.2.10, 9.3.2.10.1.1, Table Amd.1-18, Table Amd.1-19, Table Amd.1-20, Fig. Amd.1-21, 9.3.2.2, 9.3.2.3, 9.3.2.10, 9.3.2.10.1.1, Table Amd.1-18, Table Amd.1-19, Table Amd.1-20, Fig. Amd.1-21, 9.3.2.1

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Atmel Germany GmbH ATTN: Dr. Bertram Koch Patent Division IPM Theresienstr. 2 74072 Heilbronn Germany Tel: +49(7131)67-3254 Fax: +49(7131)67-2789 Email: Bertram.Koch@hno.atmel.com	10050878.2-31 DE, 09/929703 US, 1508/01 CH, 0113094 FR, 10138217.0 DE, 10/353298 US, 02767283.1-2210 FR, 02767283.1-2210 FI, 50202435.6-08 DE, 10335009.8 DE, 10/896670 Us, 04017298.3-1237 EP, 200410054468.5 CN, 102004019309.6 DE, 05007835.1-2210 EP, 11/104435 US, 102004014563.6 DE, 11/087871 us, 200510059501.8 CN, 10158442.3-09 DE, 10256099.4 DE, 02026665.6.1248 EP, 10/308248 US, 10301451.9 DE, 10/753859 US, 04000202.41248 EP, 2004-4143 JP, 200410002008.8 CN, 10325399.8 DE, 0 012309 3-241 E, 10/855866 US, 2004-157635 JP, 10357665.7 DE, 10/753849 US, 04000203.2-2207 EP, 200410002047.8 CN, 2004-5689 JP, 10356259.1-35 DE, 11/002852 US, 200410098306.1 CN, 102005032590.4- 35 DE, PCT/EP2005/007 496 WO, 102004007106.3 DE, 11/058056 US, 200510008328.9 CN	6.3.1.2.2, 6.3.1.2.3, 6.3.1.2.5, 6.3.1.2.8, 6.3.1.5, 6.3.1.3.1, 6.3.1.3, 6.3.2.10.3, 6.3.2.2, 6.3.2.3
BTG International Ltd ATTN: Mr Mathew Frankel Senior Legal Advisor 10 Fleet Place Limeburner Lane London EC4M 7SB UK Tel: +44 20 7575 0000 Fax: +44 20 7575 0010 Website: www.btgplc.com Email: info@btgplc.com	CHINA 98117396.9; EUROPE 98306849.5; JAPAN 241748.98; UNITED STATES OF AMERICA 09/138560; SOUTH AFRICA 987635 ; CHINA 98117442.6; CHINA 200410045765.3; EUROPE 98306943.6; JAPAN 10-243364; UNITED STATES OF AMERICA 09/143711; SOUTH AFRICA 987838; CHINA 98119594.6; JAPAN 272945/98; UNITED STATES OF AMERICA 09/160354; SOUTH AFRICA 988956; CHINA 99111121.4; EUROPE 99304836.2; JAPAN 171775/1999; UNITED STATES OF AMERICA 09/334151; UNITED STATES OF AMERICA 10/827814; SOUTH AFRICA 985286; SOUTH AFRICA 994046; AUSTRIA 99308924.2; BELGIUM 99308924.2; SWITZERLAND 99308924.2; CHINA 99122449.3; GERMANY 99308924.2; EUROPE 99308924.2; SPAIN 99308924.2; FRANCE 99308924.2; ITALY 99308924.2; JAPAN 318426/1999; NETHERLANDS 99308924.2; UNITED STATES OF AMERICA 435467; CHINA 00104540.7; EUROPE 00300753.1; JAPAN 2000-023891; UNITED STATES OF AMERICA 09/495456; SOUTH AFRICA 2000/0668; CHINA 00121458.6; EUROPE 00306298.1; JAPAN 2000-222353; UNITED STATES OF AMERICA 09/624006; SOUTH AFRICA 2000/3699; EUROPE 01304980.4; JAPAN 2001-177175; UNITED STATES OF AMERICA 09/877438; SOUTH AFRICA 2001/4484; CHINA 01115964.2; EUROPE 01305116.4; JAPAN 2001-177567; UNITED STATES OF AMERICA 09/878403;	???

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		ETSI EN 302 208-2 US Code of Federal Regulations (CFR) Title 47, Chapter I, Part 15 **Types A, B, C** Table 2 — Interrogator-to-tag (R=>T) communications: Int:1d Frequency Hop Rate (frequency-hopping [FHSS] systems) Int:1e Frequency Hop Sequence (frequency-hopping [FHSS] systems) Table 3 — Tag-to-interrogator (T=>R) communications: Tag:1d Frequency Hop Rate (frequency-hopping [FHSS] systems) Tag:1e Frequency Hop Sequence (frequency-hopping [FHSS] systems) **Types A, B** 6.4 Frequency hopping carrier rise and fall times **Type C** 9.3.1.2.9 Frequency-hopping spread-spectrum waveform 9.3.1.2.10 Frequency-hopping spread-spectrum channelisation Annex I Dense- and multiple-interrogator channelised signaling Bibliography: ETSI EN 300 220 ETSI EN 302 208-1 ETSI EN 302 208-2 US Code of Federal Regulations (CFR) Title 47, Chapter I, Part 15 **Type A, B** 6.5.5 Message Format 6.5.6 Return preamble **Type C** 9.3.1.3.3 Tag supported Tari values and backscatter link rates **Type C** 9.1.1 Physical layer Table 3: Tag:7e Subcarrier Frequency Tag:7g Subcarrier Modulation Tag:7h Duty Cycle Tag:8 Data Coding Tag:9 Bit Rate 9.3.1.3 Tag-to-interrogator (T=>R) communications 9.3.1.3.2 Data encoding 9.3.1.3.2.3 Miller-modulated subcarrier Figure Amd.1-16 — Subcarrier sequences 9.3.1.3.2.4 Miller subcarrier preamble 9.3.1.3.3 Tag supported Tari values and backscatter link rates Table Amd.1-11 — Tag-to-interrogator link frequencies Annex I Dense- and multiple-

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		interrogator channelised signaling CLAIMS 11-et seq **Types A, B, C** Table 2: Int:1d Frequency Hop Rate (frequency-hopping [FHSS] systems) Int:1e Frequency Hop Sequence (frequency-hopping [FHSS] systems) Table 3: Tag:1d Frequency Hop Rate (frequency-hopping [FHSS] systems) Tag:1e Frequency Hop Sequence (frequency-hopping [FHSS] systems) **Types A, B** 6.4 Frequency hopping carrier rise and fall times **Type C** 9.3.1.2.9 Frequency-hopping spread-spectrum waveform 9.3.1.2.10 Frequency-hopping spread-spectrum channelisation Annex I Dense- and multiple-interrogator channelised signaling Bibliography: ETSI EN 300 220 ETSI EN 302 208-1 ETSI EN 302 208-2 US Code of Federal Regulations (CFR) Title 47, Chapter I, Part 15 **Type A** 7.8.9 Write single block 7.8.10 Write multiple blocks 7.8.11 Lock single block 7.8.12 Write AFI 7.8.13 Lock AFI 7.8.14 Write DSFID command 7.8.15 Lock DSFID **Type B** 8.2.1.3.3 WRITE_OK 8.2.7.9.11 WRITE 8.2.7.9.12 WRITE4BYTE 8.2.7.9.13 LOCK 8.2.7.9.14 QUERY_LOCK 8.2.7.9.15 WRITE_MULTIPLE 8.2.7.9.16 WRITE4BYTE_MULTIPLE **Type C** 9.3.2.10.3.3 Write (mandatory) 9.3.2.10.3.4 Kill (mandatory) 9.3.2.10.3.5 Lock (mandatory) 9.3.2.10.3.7 BlockWrite (optional) 9.3.2.10.3.8 BlockErase (optional) Annex E State-transition tables **Type A** Tag state storage **Type B** 8.2.1.3.2 Data exchange status bit (DE_SB)

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		Type C persistent memory or persistent flag 9.3.2.2 Sessions and inventoried flags 9.3.2.3 Selected flag 9.3.2.7 Selecting tag populations 9.3.2.8 Inventorying tag populations 9.3.2.10.1.1 Select (mandatory) 9.3.2.10.2.1 Query (mandatory) 9.3.2.10.2.2 QueryAdjust (mandatory) 9.3.2.10.2.3 QueryRep (mandatory) Annex E State-transition tables Annex F Command-Response Tables
Magellan Technology Pty Limited ATTN: Ms E. J. Angus Company Secretary 65 Johnston St ANNANDALE NSW 2038 Australia Tel: +61 2 9562 9800 Fax: +61 2 9518 7620 E-mail : jeana@magtech.com.au	US10/204159 USA , AU3711301 Australia , WO0165712 International PCT, EP1266458 Europe , 2003526148 Japan	6, 7, 8, 9
OMRON Corporation ATTN: Atsuhsi Hisano Business Development Group Planning Division Business Management Department Gate City Ohsaki West Tower 14F, 1-11-1, Ohsaki, Shinagawa-ku, Tokyo, 141-0032 Japan Tel: +81(3)5435-2004 Fax: +81(3)5435-2025 Email: atsushi_hisano@omron.co.jp	2949728/ Japan	6.3.1.3.3
Koninklijke Philips Electronics N.V. ATTN: Harald Röggla Triester Strasse 64 1101 Vienna Austria Tel: 43(1)60101 1469 Fax: +43(1)60101 1101 Email: harald.roeggla@philips.com	AT 401 127/ AT;EP 0 669 591 / BE, CH, De, DK, ES, FR, GB, IT, LI, NL, SE;EP 1 038 257 /AT, DE, ES, FR, GB, IT;IN /PCT/00/00034 / IN;US10/382262;JP00-561579 / JP;	2.5.1
Symbol Technologies, Inc. ATTN: Aaron Bernstein, VP of IP, Legal Department One Symbol Plaza, MS A6 Holtsville, NY 11742 USA Tel: 1-800-927-9626 Fax 1-631-738-4110 E-mail aaron.bernstein@symbol.com	6,784,813 (USA); 10/926,269 (USA); 10/932,279 (USA); 761843 (AU); 2,310,623 (CA); 98812462.9 (CN); 1031120 (DE); 1031120 (EP); 1320062 (EP); 1031120 (FR); 1031120 (GB); 1032468 (HK); 136,220 (IL); 1031120 (IT); 2000-521687 (JP); 10/688,535 (USA); 2003282941 (AU); TBA (CN); TBA (EP); TBA (JP); TBA (KR); 10/725,010 (USA); 10/073,000 (USA); 10/072,885 (USA); 10/693,687 (USA); 2003286702 (AU); TBA (CA); TBA (CN); 03777912.1 (EP); TBA (JP); 10-2005-7007116 (KR); TBA (SG); 10/927,775 (USA); US04/027999(WO); 2,503,407 (CA); TBA (EP); TBA (JP); 0480001172.5 (CN); 1020057007371 (KR); 2004269728 (AU)	Type C

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TAGSYS, S.A. ATTN: Alastair McArthur, CTO 180 Chemin de Saint Lambert 13821 La Penne sur Huveaune France Tel: +33(0)4 91 27 57 01 Fax: +33(0)4 91 27 57 00 E-mail: alastair.mcarthur@tagsys.net	US 6,641,036; EP 1232471; WO 02054365; WO 0141043; EP 0953181; US 6,538,564	???
Texas Instruments Incorporated ATTN: Mrs. Scharlene Franks Contract Manager, RFID Business Group 6550 Chase Oaks Boulevard, MS 8470 Plano, Texas 75023 USA Tel: +1(214) 567-8830 Fax: +1(214) 567-2409 Email: s-franks@ti.com	NONE	Not applicable
Zebra Technologies Corporation ATTN: Eric McAlpine IP Counsel Legal Dept. 333 Corporate Woods Parkway Vernon Hills, IL 60061 USA Phone: 1.847.793.5640 Fax: 1.847.955.4514 E-mail: emcalpine@zebra.com	92/10006 AUSTRALIA; BW/A/97/00142 BOTSWANA; 2058692 CANADA; 02017523.8 EPC; 95112753.9 EPC (AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LU, NL, PT, SE); 92300041.8 EPC (AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LU, NL, PT, SE); 91/346821 JAPAN; 9609578-1 SINGAPORE; 92/0039 SOUTH AFRICA; 08/976949 USA; 07/816893 USA; 08/976948 USA; 326618 ARGENTINA; 93/50781 AUSTRALIA; BW/A/97/00141 BOTSWANA; PI9304761-4 BRAZIL; 2103288 CANADA; 93121410 CHINA; 01117486.9 EPC; 97104997.8 EPC (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, NL, PT, SE); 97104998.6 EPC (AT, BE, CH, DK, DE, ES, FR, GB, GR, IE, IT, NL, PT, SE); 93309232.2 EPC (AT, BE, CH, ES, FR, GB, GR, IE, IT, NL, PT, SE); 0598624UKREG GUERNSEY; 98109976.2 HONG KONG; 93/01312 INDIA; 107636 ISRAEL; 47219/03 JAPAN; 93/289591 JAPAN; 0598624UKREG JERSEY; 93/02408 MALAYSIA; 9307214 MEXICO; 250219 NEW ZEALAND; 314270 NEW ZEALAND; 314269 NEW ZEALAND; 19934177 NORWAY; 19993092 NORWAY; 19993091 NORWAY; 93051222 RUSSIAN FEDERATION; 9609092-3 SINGAPORE; 93/8624 SOUTH AFRICA; 93/024833 SOUTH KOREA; 82109793 TAIWAN; 93003717 UKRAINE; 08/154329 USA; 08/580913 USA; 95/16530 AUSTRALIA; 93/44940 AUSTRALIA; BW/A/97/00144 BOTSWANA; 2104829 CANADA; 93118806 CHINA; 93306790.2 EPC (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MN, NL, PT, SE); 93/00956 INDIA; 108621 ISRAEL; 93/211454 JAPAN; 93049090 RUSSIAN FEDERATION; 9608519-6	???

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	745638; AUSTRALIA 764975; EPC (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, NL, PT, SE) 0789253; EPC (AT, BE, CH, DK, DE, ES, FR, GB, GR, IE, IT, NL, PT, SE) 0789254; EPC (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, NL, SE) 0983569; HONG KONG 1009295; EPC (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MN, NL, PT, SE) 1031046; EPC (BE, DE, DK, ES, FI, FR, GB, IE, IT, NL, SE) 1280092; EPC 1291671; CANADA 2058692; CANADA 2103288; CANADA 2104829; RUSSIAN FEDERATION 2126165; RUSSIAN FEDERATION 2156540; RUSSIAN FEDERATION 2238585; JAPAN 3100716; JAPAN 3290003; USA 5519381; USA 5537105; USA 5557280; USA 5680459; USA 5699066; USA 5726630; USA 5966083; USA 5995017; USA 6661336; USA 6784787; BRAZIL 9304761-4; CHINA 93118806.7; CHINA 93121410.6	

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Page 1, clause 1

Replace paragraph 2 with the following paragraphs:

This part of ISO/IEC 18000 contains one mode with three types. All three types are ITF. Type A uses Pulse-Interval Encoding (PIE) in the forward link and an adaptive ALOHA collision-arbitration algorithm. Type B uses Manchester in the forward link and an adaptive binary-tree collision-arbitration algorithm. Type C uses Pulse-Interval Encoding (PIE) in the forward link and a random slotted collision-arbitration algorithm. The detailed technical differences between the three types are shown in the associated parameter tables.

This part of ISO/IEC 18000 specifies

— physical interactions (the signalling layer of the communication link) between interrogators and tags,

— interrogator and tag operating procedures and commands, and

— the collision arbitration scheme used to identify a specific tag in a multiple-tag environment.

Page 1, clause 2

Replace the whole clause with the following clause:

2 Conformance

2.1 Claiming conformance

To claim conformance with this part of ISO/IEC 18000, an interrogator or tag shall comply with all relevant clauses of this part of ISO/IEC 18000, except those marked as “optional”. The interrogator or tag shall also operate within local radio regulations, which may further restrict operation.

Relevant conformance test methods will be provided in a future Technical Report (ISO/IEC TR 18047-6).

Conformance may also require a license from the owner of any intellectual property utilized by said device.

2.2 Interrogator conformance and obligations

To conform to this part of ISO/IEC 18000, an interrogator shall

— support at least one type of A, B or C – it may optionally support two or all three;

— implement the mandatory commands defined in this part of ISO/IEC 18000;

— modulate/transmit and receive/demodulate a sufficient set of the electrical signals defined in the signalling layer of this part of ISO/IEC 18000 to communicate with conformant tags; and

— operate within applicable local regulations.

To conform to this part of ISO/IEC 18000, an interrogator may

— implement any subset of the optional commands defined in this part of ISO/IEC 18000, and

— implement any proprietary and/or custom commands in conformance with this part of ISO/IEC 18000.

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To conform to this part of ISO/IEC 18000, the interrogator shall not

— implement any command that conflicts with this part of ISO/IEC 18000, or

— require using an optional, proprietary, or custom command to meet the requirements of this part of ISO/IEC 18000.

2.3 Tag conformance and obligations

To conform to this part of ISO/IEC 18000, a tag shall

— support at least one type of A, B or C – it may optionally support two or all three;

— operate over the frequency range from 860 MHz to 960 MHz, inclusive;

— implement the mandatory commands defined in this part of ISO/IEC 18000;

— modulate a backscatter signal only after receiving the requisite command from an interrogator; and

— conform to local radio regulations.

To conform to this part of ISO/IEC 18000, a tag may

— implement any subset of the optional commands defined in this part of ISO/IEC 18000; and

— implement any proprietary and/or custom commands as defined in clauses 7, 8 and 9 of this part of ISO/IEC 18000.

To conform to this part of ISO/IEC 18000, a tag shall not

— implement any command that conflicts with this part of ISO/IEC 18000;

— require using an optional, proprietary, or custom command to meet the requirements of this part of ISO/IEC 18000; or

— modulate a backscatter signal unless commanded to do so by an interrogator using the signalling layer defined in ISO/IEC 18000.

Page 2, clause 3

Insert the following paragraph as first paragraph:

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Page 2, clause 3

Delete the following normative reference and associated footnote:

ISO/IEC 19762-3, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 3: Radio frequency identification (RFID)*[1)]

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Page 2, clause 3

Insert the following normative references:

ISO/IEC 15961, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: application interface*

ISO/IEC 15962, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: data encoding rules and logical memory functions*

ISO/IEC 15963, *Information technology — Radio frequency identification for item management — Unique identification for RF tags*

ISO/IEC 18000-1, *Information technology — Radio frequency identification for item management — Part 1: Reference architecture and definition of parameters to be standardized*

ISO/IEC 19762 (all parts), *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

EPCglobal™ Tag Data Standards version 1.3 and above, EPCglobal™

Page 2, clause 4.1

Replace the introductory paragraph with the following:

For the purposes of this document, the terms and definitions given in ISO/IEC 19762 (all parts) and the following apply.

Page 2, clause 4.1

Insert the following terms and definitions:

4.1.3
command set
set of commands used to explore and modify a tag population

4.1.4
continuous wave
typically sinusoid at a given frequency, but more generally any interrogator waveform suitable for powering a passive tag without amplitude and/or phase modulation of sufficient magnitude to be interpreted by a tag as transmitted data

4.1.5
cover-coding
method by which an interrogator obscures information that it is transmitting to a tag; to cover-code data or a password an interrogator first requests a random number from the tag, then performs a bit-wise EXOR of the data or password with the received random number, and, finally, transmits the cover-coded (also called ciphertext) string to the tag; the tag uncovers the data or password by performing a bit-wise EXOR of the received cover-coded string with the original random number

4.1.6
dense-interrogator environment
operating environment (4.1.13) within which most or all of the available channels are occupied by active interrogators

EXAMPLE 25 active interrogators operating in 25 available channels.

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4.1.7
dense-interrogator mode

set of interrogator-to-tag and tag-to-interrogator signalling parameters used in dense-interrogator environments

4.1.8
EPCglobal™ Application

application whose usage denotes an acceptance of EPCglobal™ standards and policies

NOTE Compare non-EPCglobal™ Application (4.1.12).

4.1.9
inventoried flag

flag that indicates whether a tag may respond to an interrogator; tags maintain a separate **inventoried** flag for each of four sessions, where each flag has symmetric *A* and *B* values within any given session, and in which interrogators typically inventory tags from *A* to *B* followed by a re-inventory of tags from *B* back to *A* (or vice versa)

4.1.10
inventory round

period initiated by a *Query* command and terminated by either a subsequent *Query* command (which also starts a new inventory round) or a *Select* command

4.1.11
multiple-interrogator environment

operating environment (4.1.13) within which a modest number of the available channels are occupied by active interrogators

EXAMPLE 5 active interrogators operating in 25 available channels.

4.1.12
non-EPCglobal™ Application

application whose usage does not denote an acceptance of EPCglobal™ standards and policies

NOTE Compare EPCglobal™ Application (4.1.8).

4.1.13
operating environment

region within which an interrogator's RF transmissions are attenuated by less than 90 dB

NOTE 1 In free space, the operating environment is a sphere whose radius is approximately 1000 m, with the interrogator located at the centre.

NOTE 2 In a building or other enclosure, the size and shape of the operating environment depends on factors such as the material properties and shape of the building, and may be less than 1000 m in certain directions and greater than 1000 m in other directions

4.1.14
operating procedure
tag-identification layer

set of functions and commands used by an interrogator to identify and modify tags

4.1.15
permalock or permalocked

memory location whose lock status is unchangeable (i.e. the memory location is permanently locked or permanently unlocked)

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4.1.16
persistent memory or persistent flag
memory or flag value whose state is maintained during a brief loss of tag power

4.1.17
physical layer
data coding and modulation waveforms used in interrogator-to-tag and tag-to-interrogator signalling

4.1.18
random-slotted collision arbitration
collision-arbitration algorithm where tags load a random (or pseudo-random) number into a slot counter, decrement this slot counter based on interrogator commands, and reply to the interrogator when their slot counter reaches zero

4.1.19
session
inventory process comprising an interrogator and an associated tag population; an interrogator chooses one of four sessions and inventories tags within that session; the interrogator and associated tag population operate in one and only one session for the duration of an inventory round (4.1.10); for each session, tags maintain a corresponding **inventoried** flag; sessions allow tags to keep track of their inventoried status separately for each of four possible time-interleaved inventory processes, using an independent **inventoried** flag for each process

4.1.20
single-interrogator environment
operating environment (4.1.13) within which there is a single active interrogator at any given time

4.1.21
singulation
identifying an individual tag in a multiple-tag environment

4.1.22
slot
point in an inventory round at which a tag may respond, which corresponds to the value output by a tag's slot counter

NOTE Tags reply when their slot (i.e. the value in their slot counter) is zero.

Page 2, clause 4.2

Insert the following symbols:

BLF	Backscatter-link frequency (BLF = $1/T_{pri}$ = DR/TRcal)
DR	Divide ratio
FDM	Frequency-division multiplexing
FT	Frequency tolerance
M_h	RF signal envelope ripple (overshoot)
M_{hh}	FHSS signal envelope ripple (overshoot)
M_{hl}	FHSS signal envelope ripple (undershoot)
M_{hs}	FHSS signal level during a hop
M_l	RF signal envelope ripple (undershoot)
M_s	RF signal level when OFF

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Q	Slot-count parameter. *Q* is an integer in the range (0,15)
R=>T	Interrogator-to-tag (reader-to-tag)
RTcal	Interrogator-to-tag (reader-to-tag) calibration symbol
T=>R	Tag-to-interrogator (tag-to-reader)
T_1	Time from interrogator transmission to tag response
T_2	Time from tag response to interrogator transmission
T_3	Time an interrogator waits, after T_1, before it issues another command
T_4	Minimum time between interrogator commands
T_f or $T_{f,10\text{-}90\%}$	RF signal envelope fall time
T_{hf}	FHSS signal envelope fall time
T_{hr}	FHSS signal envelope rise time
T_{hs}	Time for an FHSS signal to settle to within a specified percentage of its final value
T_{pri}	Backscatter-link pulse-repetition interval (T_{pri} = 1/BLF = TRcal/DR)
T_r or $T_{r,10\text{-}90\%}$	RF signal envelope rise time
TRcal	Tag-to-interrogator (tag-to-reader) calibration symbol
T_s	Time for an RF signal to settle to within a specified percentage of its final value
UII	Unique Item Identifier
x_{fp}	floating-point value
$xxxx_2$	binary notation
$xxxx_h$	hexadecimal notation

Page 2, clause 4.2

Replace the following symbols:

Tari	Reference time interval for a data-0 in interrogator-to-tag signalling

Page 3, clause 4.3

Insert the following abbreviated terms:

Ciphertext	Information that is cover-coded
CW	Continuous wave
dBch	Decibels referenced to the integrated power in the reference channel
DSB	Double sideband
DSB-ASK	Double-sideband amplitude-shift keying
EPC™	Electronic product code
FCC	Federal Communications Commission
Handle	16-bit tag-authentication number
ITF	Interrogator-talks-first (Note: the common usage is RTF (Reader-talks-first) but the more precise term is ITF, which is used throughout the document.)
NSI	Numbering system identifier
Pivot	Decision threshold differentiating an R=>T data-0 symbol from a data-1 symbol

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Plaintext	Information that is not cover-coded
ppm	parts per million
PR-ASK	Phase-reversal amplitude shift keying
RFU	Reserved for future use
RN16	16-bit random or pseudo-random number
RNG	Random or pseudo-random number generator
SSB	Single sideband
SSB-ASK	Single-sideband amplitude-shift keying
TID	Tag-identification or tag identifier, depending on context
Word	16 bits

Page 4, before clause 5

Insert the following new subclause:

4.4 Notation

This part of ISO/IEC 18000 uses the following notational conventions for type C:

— States and flags are denoted in bold. Example: **ready**.

— Commands are denoted in italics. Variables are also denoted in italics. Where there might be confusion between commands and variables, this specification will make an explicit statement. Example: *Query*.

— Command parameters are underlined. Example: Pointer.

— For logical negation, labels are preceded by '~'. Example: If **flag** is true, then **~flag** is false.

— The symbol, R=>T, refers to commands or signalling from an interrogator to a tag (reader-to-tag).

— The symbol, T=>R, refers to commands or signalling from a tag to an interrogator (tag-to-reader).

Page 4, clause 5.1

Replace clause 5.1 by the following clause:

5.1 General

This part of ISO/IEC 18000 specifies three communication types: Type A, Type B and Type C.

Figure 1, Figure 2, and Figure 3 show the architecture of each of the three interrogator types. Figure Amd.1-1, Figure Amd.1-2, and Figure Amd.1-3 show the architecture of each of the three tag types.

Table 1 provides an overview of the three communication types showing the protocol blocks from interrogator input (demodulator) to interrogator output (modulator) independent of the communication flow.

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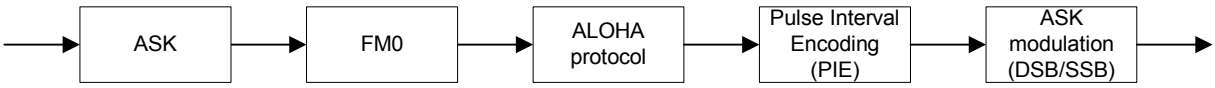

Figure 1 — Type A interrogator architecture

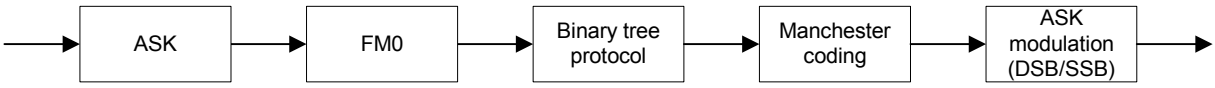

Figure 2 — Type B interrogator architecture

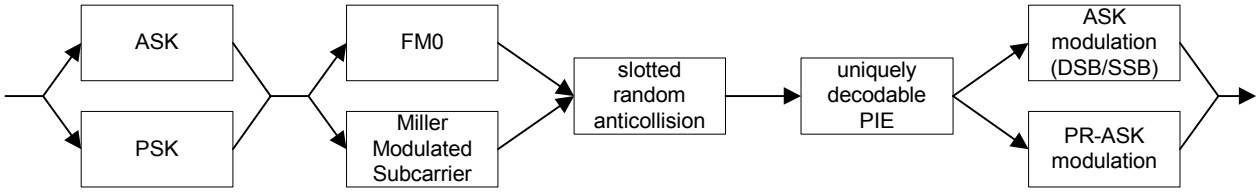

Figure 3 — Type C interrogator architecture

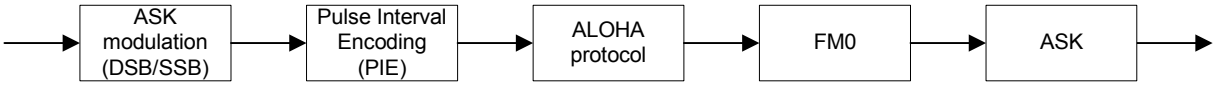

Figure Amd.1-1 — Type A tag architecture

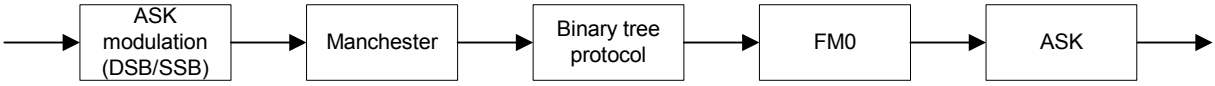

Figure Amd.1-2 — Type B tag architecture

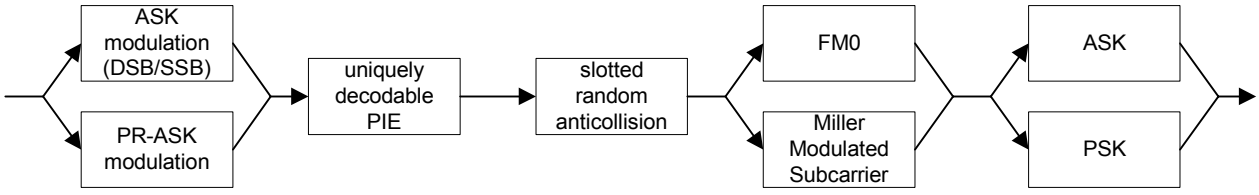

Figure Amd.1-3 — Type C tag architecture

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Table 1 — Overview of Types A, B and C

Parameter	Type A	Type B	Type C
Forward link encoding	PIE	Manchester	Uniquely decodeable PIE
Modulation depth	27% to 100%	30.5% or 100%	80% to 100%
Data rate	33 kbit/s (assuming equiprobable data)	10 or 40 kbit/s (according to local regulations)	26.7 kbit/s to 128 kbit/s (assuming equiprobable data)
Return link encoding	FM0	FM0	FM0, Miller subcarrier
Collision arbitration	ALOHA / FST	Binary Tree	random slotted collision-arbitration
Tag unique identifier	64 bits (40 bit SUID)	64 bits	Variable: minimum 16 bits, maximum 496 bits
Memory addressing	Blocks up to 256 bits	Byte blocks, 1,2,3 or 4 byte writes	Bit, word (16-bit), or vendor-defined block boundaries (depending on command)
Error detection, forward link	5 bit CRC for all commands (with an additional 16-bit CRC appended for all long commands)	16-bit CRC	16-bit CRC, except a 5-bit CRC for the *Query* command
Error detection, return link	16-bit CRC	16-bit CRC	16-bit CRC, except no error check for RN16
Collision arbitration linearity	2048	Up to 2^{256}	Linear up to 2^{15} tags in the interrogator's RF field; above that number, N log(N) for tags with unique UIIs

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Page 6, Table 2

Replace Table 2 with the following table:

Table 2 — Interrogator-to-tag link parameters

Ref.	Parameter Name	Description	Ref Type C
Int:1	Operating Frequency Range	**Types A and B:** 860 – 960 MHz The interrogator operating frequency range shall be determined by the radio regulations in force in a particular regulatory jurisdiction and by the type approval requirements of the particular jurisdiction. Before an interrogator may be used, it shall meet the local radio regulations of the country in which it is to be used. It is envisaged that there will be more than one version of interrogator having different frequency and power characteristics in order to comply with local regulations. NOTE Performance will vary according to bandwidth and power output permitted by local regulations. **Type C:** 860 MHz – 960 MHz, as required by local regulations	See clause 9.3.1.1
Int:1a	Default Operating Frequency	**Types A and B:** In accordance with the local radio regulations. See Int: 1 **Type C:** Determined by local radio regulations and by the radio-frequency environment at the time of the communication	See clause 9.3.1.1
Int:1b	Operating Channels (spread-spectrum systems)	**Types A and B:** In accordance with the local radio regulations. See Int: 1 **Type C:** In accordance with local regulations; if the channelisation is unregulated, then as specified	See clause 9.3.1.2.10, Annex I
Int:1c	Operating Frequency Accuracy	**Types A and B:** In accordance with the local radio regulations See Int: 1 **Type C:** As specified	See clause 9.3.1.2.1
Int:1d	Frequency Hop Rate (frequency-hopping [FHSS] systems)	**Types A and B:** Not applicable for single fixed frequency or channelized Adaptive Frequency Agile systems. Where FHSS is permitted, the hop rate shall be in accordance with the local radio regulations. **Type C:** In accordance with local regulations	See clause 9.3.1.2.9

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Ref.	Parameter Name	Description	Ref Type C
Int:1e	Frequency Hop Sequence (frequency-hopping [FHSS] systems)	**Types A and B:** In accordance with the local radio regulations. Where not specified by such regulations a pseudo-random hopping sequence shall be used that ensures an even distribution of transmissions over the available channels. **Type C:** In accordance with local regulations	See clause 9.3.1.2.9
Int:2	Occupied Channel Bandwidth	In accordance with local regulations	
Int:2a	Minimum Receiver Bandwidth	In accordance with local regulations	
Int:3	Interrogator Transmit Maximum EIRP	In accordance with local regulations	
Int:4	Interrogator Transmit Spurious Emissions	**Types A and B:** In accordance with the local radio regulations. **Type C:** As specified; tighter emission limits may be imposed by local regulations	See clause 9.3.1.2.11
Int:4a	Interrogator Transmit Spurious Emissions, In-Band (spread-spectrum systems)	**Types A and B:** In accordance with the local radio regulations. **Type C:** As specified; tighter emission limits may be imposed by local regulations	See clause 9.3.1.2.11
Int:4b	Interrogator Transmit Spurious Emissions, Out-of-Band	**Types A and B:** In accordance with the local radio regulations. **Type C:** As specified; tighter emission limits may be imposed by local regulations	See clause 9.3.1.2.11
Int:5	Interrogator Transmitter Spectrum Mask	**Types A and B:** As per Int: 2 and Int: 4a. **Type C:** As specified; tighter emission limits may be imposed by local regulations	Figure Amd.1-9, Figure Amd.1-10
Int:6	Timing	**Types A and B:** See below Int: 6x. **Type C:** As specified	See clause 9.3.1.6, Figure Amd.1-19, Table Amd.1-15
Int:6a	Transmit-to-Receive Turn-Around Time	**Types A and B:** The interrogator transmit/receive settling time shall not exceed 85 µs. **Type C:** MAX(RTcal,$10T_{pri}$) nominal	See clause 9.3.1.6, Figure Amd.1-19, Table Amd.1-15
Int:6b	Receive-to-Transmit Turn-Around Time	**Types A and B:** As determined by the communication protocol – refer Tag: 6a. **Type C:** $3T_{pri}$ minimum; $20T_{pri}$ maximum when tag is in **reply** & **acknowledged** states; no limit otherwise	See clause 9.3.1.6, Figure Amd.1-19, Table Amd.1-15
Int:6c	Dwell Time or interrogator Transmit Power-On Ramp	1500 µs, maximum settling time	See clause 9.3.1.2.6, Figure Amd.1-6, Table Amd.1-8
Int:6d	Decay Time or interrogator Transmit Power-Down Ramp	**Types A and B:** Maximum 1 ms. **Type C:** 500 µs, maximum	Figure Amd.1-6, Table Amd.1-9
Int:7	Modulation	**Types A and B:** Amplitude Modulation. **Type C:** DSB-ASK, SSB-ASK, or PR-ASK	See clause 9.3.1.2.2

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Ref.	Parameter Name	Description	Ref Type C
Int:7a	Spreading Sequence (direct-sequence [DSSS] systems)	Not applicable.	
Int:7b	Chip Rate (spread-spectrum systems)	Not applicable.	
Int:7c	Chip Rate Accuracy (spread-spectrum systems)	Not applicable.	
Int:7d	Modulation Depth	**Type A**: Nominal 30 % to 100 %. See Table 11 and clause 7.1.1. **Type B**: Nominal 18% or 100% . **Type C:** 90% nominal	See clause 9.3.1.2.5, Figure Amd.1-5, Table Amd.1-7
Int:7e	Duty Cycle	**Types A and B:** In accordance with local regulations. **Type C:** 48% – 82.3% (time the waveform is high)	See clause 9.3.1.2.3, Figure Amd.1-4, Table Amd.1-7
Int:7f	FM Deviation	Not applicable.	
Int:8	Data Coding	**Type A**: Pulse Interval Encoding **Type B**: Manchester bi-phase **Type C:** PIE	See clause 9.3.1.2.3, Figure Amd.1-4
Int:9	Bit Rate	**Type A**: 33 kbit/s as constrained by the local radio regulations **Type B**: 10 kbit/s or 40 kbit/s as constrained by the local radio regulations. **Type C:** 26.7 kbit/s to 128 kbit/s (assuming equiprobable data)	See clause 9.3.1.2.4
Int:9a	Bit Rate Accuracy	**Types A and B:** 100 ppm **Type C:** +/– 1%, minimum	See clause 9.3.1.2.4
Int:10	Interrogator Transmit Modulation Accuracy	**Types A and B:** Not applicable. **Type C:** As specified	See clause 9.3.1.2.4
Int:11	Preamble	**Type A**: has no preamble **Type B**: See clause 8.1.4.3 **Type C:** Required	See clause 9.3.1.2.8
Int:11a	Preamble Length	**Type A**: not applicable. **Type B**: 9 bits. See clause 8.1.4.3. **Type C:** As specified	See clause 9.3.1.2.8
Int:11b	Preamble Waveform(s)	**Type A**: not applicable . **Type B**: See clause 8.1.4.3. **Type C:** As specified	See Figure Amd.1-7
Int:11c	Bit Sync Sequence	**Type A**: not applicable. **Type B**: see clause 8.1.4.3 **Type C:** None	
Int:11d	Frame Sync Sequence	**Types A and B:** Not applicable. **Type C:** Required	See clause 9.3.1.2.8, Figure Amd.1-7
Int:12	Scrambling (spread-spectrum systems)	Not Applicable.	
Int:13	Bit Transmission Order	MSB is transmitted first	See clause 9.3.1.4

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Ref.	Parameter Name	Description	Ref Type C
Int:14	Wake-up process	**Types A and B:** Presence of an appropriate RF signal at the tag followed by a wake-up command as required by the tag type. See relevant clauses. **Type C:** As specified	See clause 9.3.1.3.4
Int:15	Polarization	**Types A and B:** Interrogator dependent. Not defined in this part of ISO/IEC 18000. **Type C:** Not specified	

Page 8, Table 3

Replace Table 3 with the following table:

Table 3 — Tag-to-interrogator link parameters

Ref.	Parameter Name	Description	Ref Type C
Tag:1	Operating Frequency Range	860 MHz – 960 MHz, inclusive	See clause 9.3.1.1
Tag:1a	Default Operating Frequency	**Types A and B:** The tag shall respond to an interrogator signal within the frequency range specified in Tag: 1. **Type C:** Tags respond to interrogator signals that satisfy Int:1a	See clause 9.3.1.1
Tag:1b	Operating Channels (spread-spectrum systems)	**Types A and B:** The tag shall respond to an interrogator signal within the frequency range specified in Tag: 1. **Type C:** Tags respond to interrogator signals that satisfy Int:1b	See clause 9.3.1.2.10
Tag:1c	Operating Frequency Accuracy	**Types A and B:** The tag shall respond to an interrogator signal within the frequency range specified in Tag: 1. **Type C:** As specified	See clause 9.3.1.3.3 Table Amd.1-11
Tag:1d	Frequency Hop Rate (frequency-hopping [FHSS] systems)	**Types A and B:** Not applicable **Type C:** Tags respond to interrogator signals that satisfy Int:1d	See clause 9.3.1.2.9
Tag:1e	Frequency Hop Sequence (frequency-hopping [FHSS] systems)	**Types A and B:** Not applicable **Type C:** Tags respond to interrogator signals that satisfy Int:1e	See clause 9.3.1.2.9
Tag:2	Occupied Channel Bandwidth	In accordance with local regulations	
Tag:3	Transmit Maximum EIRP	In accordance with local regulations	
Tag:4	Transmit Spurious Emissions	In accordance with local regulations	
Tag:4a	Transmit Spurious Emissions, In-Band (spread spectrum systems)	In accordance with local regulations	
Tag:4b	Transmit Spurious Emissions, Out-of-Band	In accordance with local regulations	
Tag:5	Transmit Spectrum Mask	In accordance with local regulations	

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Ref.	Parameter Name	Description	Ref Type C
Tag:6a	Transmit-to-Receive Turn-Around Time	**Type A:** The tag shall open its receive command window within 2 bit periods of the end of its response. **Type B:** 400 µs **Type C:** $3T_{pri}$ minimum, $20T_{pri}$ maximum in **reply** & **acknowledged** states; no limit otherwise	See clause 9.3.1.6, Figure Amd.1-19, Table Amd.1-15
Tag:6b	Receive-to-Transmit Turn-Around Time	**Type A :** Range from 150 to 1150 µs (see clause 7.5.3 and Table 28) **Type B :** Range 85 to 460 µs (see clause 8.1.5.2) **Type C:** MAX(RTcal,$10T_{pri}$) nominal	See clause 9.3.1.6, Figure Amd.1-19, Table Amd.1-15
Tag:6c	Dwell Time or Transmit Power-On Ramp	**Types A and B:** Not applicable. **Type C:** Receive commands 1.5 ms after power-up	See clause 9.3.1.3.4
Tag:6d	Decay Time or Transmit Power-Down Ramp	Not applicable.	
Tag:7	Modulation	**Types A and B:** Bi-state amplitude modulated backscatter. **Type C:** ASK and/or PSK modulation (selected by tag)	See clause 9.3.1.3.1
Tag:7a	Spreading Sequence (direct sequence [DSSS] systems)	Not applicable.	
Tag:7b	Chip Rate (spread spectrum systems)	Not applicable.	
Tag:7c	Chip Rate Accuracy (spread spectrum systems)	Not applicable.	
Tag:7d	On-Off Ratio	**Types A and B:** The tag Delta RCS (Varying Radar Cross Sectional area) affects system performance. A typical value is greater than $0.005m^2$. **Type C:** Not specified	
Tag:7e	Subcarrier Frequency	**Types A and B:** Not applicable. **Type C:** 40 kHz to 640 kHz	See clause 9.3.1.3.3 Table Amd.1-11
Tag:7f	Subcarrier Frequency Accuracy	**Types A and B:** Not applicable. **Type C:** As specified	Table Amd.1-11
Tag:7g	Subcarrier Modulation	**Types A and B:** Not applicable. **Type C:** Miller, at the data rate	See clause 9.3.1.3.2.3, Figure Amd.1-16
Tag:7h	Duty Cycle	**Types A and B:** The tag shall transmit its response when commanded to do so by the interrogator. **Type C:** FM0: 50%, nominal Subcarrier: 50%, nominal	See clause 9.3.1.3.2.1, 9.3.1.3.2.3
Tag:7i	FM Deviation	Not applicable.	
Tag:8	Data Coding	**Types A and B:** Bi-phase space (FM0) **Type C:** Baseband FM0 or Miller-modulated subcarrier (selected by the interrogator)	See clause 9.3.1.3.2

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Ref.	Parameter Name	Description	Ref Type C
Tag:9	Bit Rate	**Types A and B:** Typical 40 kbit/s or 160 kbit/s (subject to tag clock tolerance see Table 9), The return bit rate selection for 160 kbit/s for Type B is defined in clause 8.1.4.4.5. **Type C:** FM0: 40 kbps to 640 kbps Subcarrier modulated: 5 kbps to 320 kbps	See clause 9.3.1.3.3 Table Amd.1-11
Tag:9a	Bit Rate Accuracy	**Types A and B:** +/- 15% (refer to Table 9) **Type C:** Same as Subcarrier Frequency Accuracy; see Tag:7f	See clause 9.3.1.3.3, Table Amd.1-11, Table Amd.1-12
Tag:10	Tag Transmit Modulation Accuracy (frequency-hopping [FHSS] systems	Not applicable.	
Tag:11	Preamble	**Types A and B:** The preamble is defined in clause 6.5.6 **Type C:** Required	See clause 9.3.1.3.2.2, See clause 9.3.1.3.2.4
Tag:11a	Preamble Length	**Types A and B:** 16 bits made up of a quiet period, followed by sync, followed by a code violation followed by an orthogonal code. **Type C:** As specified	See Table Amd.1-11, See Figure Amd.1-18
Tag:11b	Preamble Waveform	**Types A and B:** Bi-phase encoded data '1'. **Type C:** As specified	See Table Amd.1-11, See Figure Amd.1-18
Tag:11c	Bit-Sync Sequence	**Types A and B:** Included in the preamble. **Type C:** None	
Tag:11d	Frame-Sync Sequence	**Types A and B:** Included in the preamble. **Type C:** None	
Tag:12	Scrambling (spread-spectrum systems)	Not applicable.	
Tag:13	Bit Transmission Order	MSB is transmitted first	See clause 9.3.1.4
Tag:14	Reserved	Deliberately left blank.	
Tag:15	Polarization	**Types A and B:** Product design feature. Not defined in this part of ISO/IEC 18000. **Type C:** Tag dependent; not specified by this document	
Tag:16	Minimum Tag Receiver Bandwidth	**Types A and B:** 860 – 960 MHz **Type C:** Tag dependent; not specified by this document.	

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Page 9, Table 4

Replace Table 4 with the following table:

Table 4 — Protocol parameters

Ref.	Parameter Name	Description	Ref Type C
P:1	Who talks first	Interrogator	See clause 9.3
P:2	Tag addressing capability	**Type A** see clause 7.3.1 **Type B** see clause 8.2.2 **Type C:** As specified	See clause 9.3.2.1
P:3	Tag UII	**Types A and B:** Contained in tag memory and accessible by means of a command. **Type C:** Contained in Tag memory	See clause 9.3.2.1
P:3a	UII Length	**Type A:** 64 bits. An SUID of 40 bits is used during census or collision arbitration transactions. **Type B:** 64 bits **Type C:** As specified	9.3.2.1.2.2
P:3b	UII Format	See clause 7.2.1 for **type A**. See clause B.2 for **type B**. **Type C:** NSI < 100_h: As specified in EPCglobal™ Tag Data Standards (Version 1.3 and above), NSI ≥ 100_h: As specified in ISO/IEC 15961	9.3.2.1.2.2 9.3.2.1.2.3 9.3.2.1.2.4
P:4	Read size	**Type A:** Addressable in blocks of up to 256 bits, but always an integer multiple of bytes. **Type B**: Addressable in byte blocks. **Type C:** Multiples of 16 bits	See clause 9.3.2.10.3.2 Table Amd.1-32
P:5	Write Size	**Type A:** Addressable in blocks of up to 256 bits, but always an integer multiple of bytes. **Type B:** Addressable in byte blocks. Writing in blocks of 1, 2, 3 or 4 bytes. See details in relevant clauses. **Type C:** Multiples of 16 bits	See clause 9.3.2.10.3.3, Table Amd.1-34, See clause 9.3.2.10.3.7, Table Amd.1-44
P:6	Read Transaction Time	**Types A and B:** A single tag can typically be identified and have its first 128 bits of user memory read in less than 10 ms. This time may vary depending on the data rate used as constrained by the local radio regulations. **Type C:** Varied with R=>T and T=>R link rate and number of bits being read	See clause 9.3.2.10.3.2
P:7	Write Transaction Time	**Types A and B:** Once a tag has been identified and selected, a 32-bit data block can typically be written in less than 20 ms. This time may vary depending on the data rate used as constrained by the local radio regulations. **Type C:** 20 ms (maximum) after end of *Write* command	See clause 9.3.2.10.3.3, See clause 9.3.2.10.3.7, Figure Amd.1-25

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Ref.	Parameter Name	Description	Ref Type C
P:8	Error detection	**Type A:** Interrogator to tag: 16-bit commands: CRC-5. Commands of more than 16 bits have an additional CRC-16, bit protection. Tag to interrogator: CRC-16 **Type B:** Interrogator to tag: CRC-16 Tag to interrogator: CRC-16 **Type C:** Interrogator-to-tag: *Select* command: CRC-16 *Query* command: CRC-5 Other Inventory commands: Command length Access commands: CRC-16 Tag-to-interrogator: PC, UII: CRC-16 RN16: None or CRC-16 (varies with command) handle: CRC-16 All other: CRC-16	See clause 9.3.2.10 and its subsections
P:9	Error correction	**Types A and B:** No forward error correction code used. Errors are handled by signalling an error to the interrogator that then repeats its last transmission. **Type C:** None	
P:10	Memory size	**Types A and B:** No minimum user memory size is specified, but if user memory is provided it shall be an integer multiples of 4 bytes. **Type C:** Tag dependent, extensible (size is neither limited nor specified by this document)	
P:11	Command structure and extensibility	**Type A:** Several command codes are reserved for future use. In addition, a Protocol extension flag allows for further extensions. **Type B:** Several command codes are reserved for future use. **Type C:** As specified	Table Amd.1-18

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Page 10, Table 5

Replace Table 5 with the following table:

Table 5 — Anti-collision parameters

Ref.	Parameter Name	Description	Ref Type C
A:1	Type (Probabilistic or Deterministic)	Probabilistic	See clause 9.3.2.6
A:2	Linearity	**Type A**: Essentially linear using adaptive slot allocation up to 256 slots for 250 tags in an interrogator zone. **Type B**: Essentially linear up to 2^{256} tags depending on size of data content. **Type C:** Linear up to 2^{15} tags in the interrogator's RF field; above that number, NlogN for tags with unique UIIs	See clause 9.3.2.8
A:3	Tag inventory capacity	**Types A and B:** The algorithm permits the reading of not less than 250 tags in the reading zone of the interrogator. **Type C:** Unlimited for tags with unique UIIs	See clause 9.3.2.8

Page 11, Figure 4

Move the figure into clause 6.2 as it is referenced in clause 6.2.

Page 11, Table 6
Move the table into clause 6.2 as it is referenced in clause 6.2.

Page 13, Clause 6.5.3

Replace the wording of clause 6.5.3 with the following wording:

The return link datarate shall be 40 or 160 kbit/s, which may be selected at the time of tag configuration. The interrogator shall be able to read and decode the tag reply at either datarate without the need to have prior knowledge of the tag configuration in order to handle mixed populations.

Page 13, Table 9

Replace Table 9 with the following table:

Table 9 — Return link parameters

Data rate	Trlb	Tolerance	Note
40kbit/s	25 µs	+/-15%	Chip set to 40kbit/s Return Link Data Rate
160kbit/s	6.25 µs	+/-15%	Chip set to 160kbit/s Return Link Data Rate

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Page 19, Table 12

Replace Table 12 with the following table:

Table 12 — Reference interval timing

Tari	Stability
10 to 20 µs	±100 ppm

Page 28, Table 20

Replace the text in row"7", column "Round size" with the following text:

1024

Page 28, Table 21

Replace Table 21 with the following modified table:

Table 21 — Command classes

Code	Class	Number of possible codes
’00’, 02’, ‘04’, ’06’, ‘0A’, and '0C' – ‘0F'	Mandatory	10
’01’, ‘03’, ‘05’, ’07’, ‘08’, ‘09’, '0B' and ‘10’ – '27', '38', '39'	Optional	32
'28' – '37'	Custom	16
'3A' – '3F'	Proprietary	6

Page 28, Clause 7.4.6.3

Replace the first paragraph with the following:

The optional command codes are ‘01’, ‘03’, ’05’, ’07’, ‘08’, ‘09’, '0B', '10' to '27', '38' and '39'.

Page 29, Clause 7.4.6.5

Replace the first paragraph with the following:

The proprietary command codes range from '3A' to '3F'. Proprietary commands may be enabled by this part of ISO/IEC 18000, but they shall not be specified in this part of ISO/IEC 18000. A proprietary command shall not solely duplicate the functionality of any mandatory or optional command defined in this part of ISO/IEC 18000 by a different method.

Page 30, Table 22

Replace the text in row "Next_Slot", column "Comments" with the following text:

The signature may be one of 16 values between 0x00 and 0x0F as transmitted by the tag in its last transmission.

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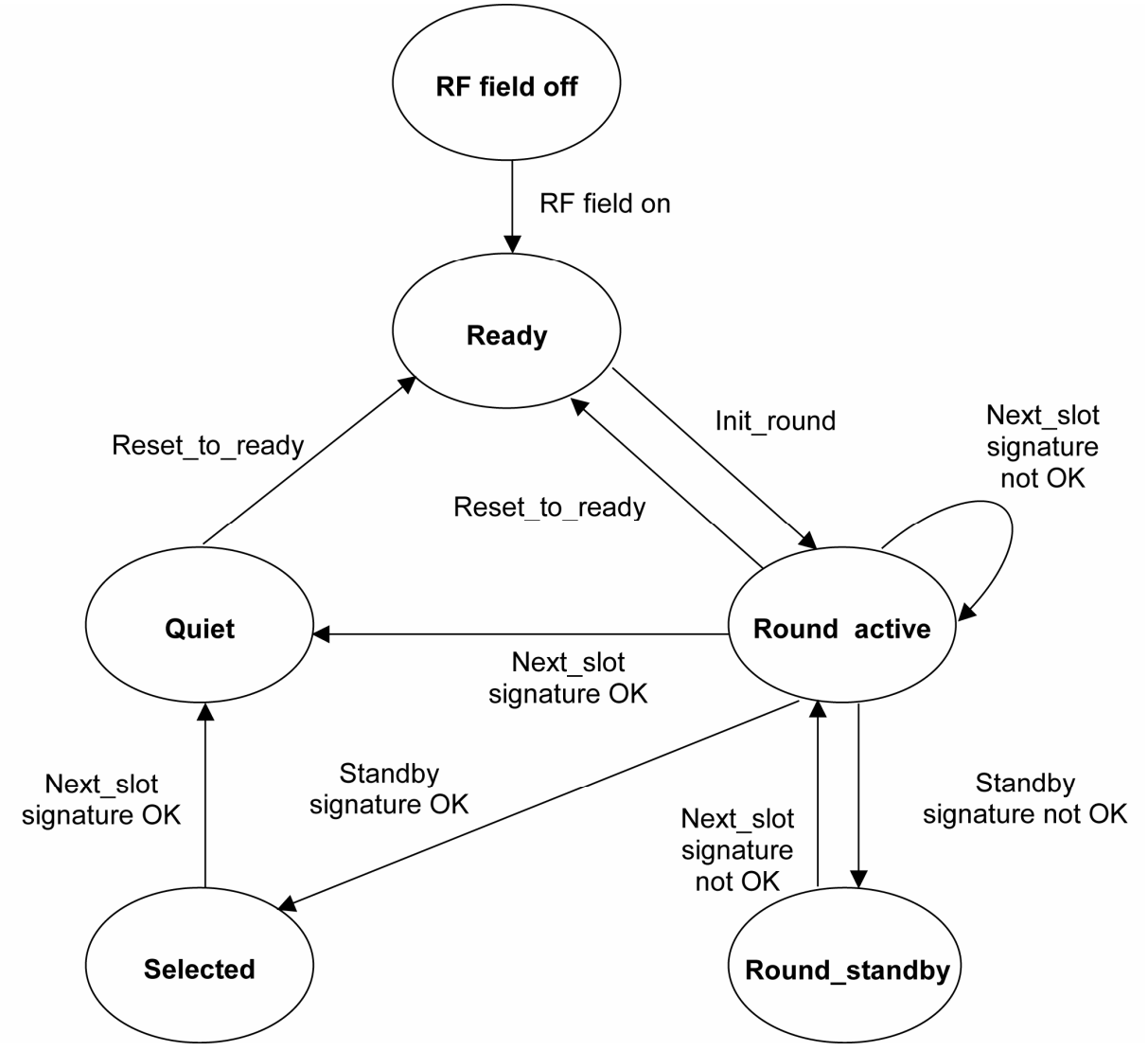
Page 30, Table 22

Insert the following row:

Command 6 bits	Op code	Parameter / flags 4 bits		CRC-5	Extended parameters	CRC-16	Comments
RFU	0x38	RFU	RFU	5 bits			
Init_Fast_Slot	0x39	SUID 1 bit	Round Size 3 bits	5 bits			SUID=0 tag responds with 1st page of user data; SUID=1 tag responds with SUID

Page 35, Figure 16

Replace Figure 16 with the following new Figure 16.



NOTE This state diagram shows some of the main transitions. State transitions are specified in detail in each command description.

Figure 16 — Tag state transition diagram

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Page 37, Clause 7.4.11

Insert the following text at the end of clause 7.4.11.

Tag manufacturer may optionally configure the tag to power-up in the FST mode. When the tag is configured to power up in FST mode, and enters the energizing field of an interrogator, it goes through a power on reset sequence and then moves to the Round_Standby state until it receives a Next_Slot, Close_Slot, New_Round or Init_Fast_Slot command, at which time it commences a Fast Slot Mode collision arbitration sequence.

Each slot has a duration at least as long as the duration of a tag preamble. The actual duration of the slot is determined by the tag and is equal to 16 tag bit times. If a tag has selected the current slot in which to transmit its reply, the Slot length is increased for that tag to the duration of a message length so that the tag can send its complete message. In order to prevent other tags (those that have not yet started their replies) from transmitting during the first tag's reply slot, the interrogator issues a MUTE command to place the tag into the Round_Standy state. After the active tag has finished transmitting its message, and if the interrogator has successfully read the tag it issues a Next_Slot command synchronously with the tag's signature. If the tag message was not successfully read then the interrogator issues a Close_Slot command, which will cause all the tags currently in the Round_Standby state to re-enter the Round_Active state.

The number of slots in a round, referred to as round size, is determined by the interrogator and is signalled to the tag in the Init_Fast_Slot or New_Round command. In the FST mode the tag elects a default roundsize of 16, which may be overridden by an interrogator command, however the FST mode is able to operate without any round initialising command. During the subsequent collision arbitration process the interrogator dynamically chooses an optimum round size for the following rounds based on the number of collisions and/or unproductive time in a round. The number of collisions is a function of the number of tags in the Round_Active state present in the interrogator field and the current round size. The interrogator signals a change in round size to tags by sending a New_Round command containing the required round size.

The tag on entering the Round_Active State or on re-entering the Round_Active state having completed a round, selects a pseudo slot at random in which to reply. Pseudo slots are equal to tag preamble in duration. If the tag has selected the first pseudo slot, it will transmit immediately, if not it will hold off until it has reached the selected pseudo-slot and then transmit.

On receiving and recognizing a valid tag transmission preamble, the interrogator sends a MUTE command (SOF), which tells all tags that have not yet started transmitting, to move to the Round_Standy state. When the interrogator receives the tag Reply without error, it sends a Next_Slot command containing the signature of the tag that it has just received.

When the tag has reached the end of a round, it will self-trigger a new round, randomly select a new slot in which to transmit and it will transmit its identity or data when it reaches the selected slot. The process continues until the tag has been successfully read and acknowledged by a valid Next_Slot command or removed from the RF energizing field.

Page 39, Clause 7.5.5.3

Replace clause 7.5.5.3. with the following text:

7.5.5.3 Tag

When a tag, in the Round active state (and not in the FST mode), has just responded in the current slot and receives a Next_slot command, which was not received within the window specified in clause 7.5.5, the tag shall not move to the quiet state, but shall remain in the Round active state and shall increment its slot counter as specified in Clause 7.7.2 and Table 31.

When a tag in the Round active state, has just responded in the current slot and receives a Standby_round command, which was not received within the window specified in clause 7.5.5, the tag shall not move to the selected state, but shall transition to the Round_standby state as specified in Clause 7.7.3 and Table 33.

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Page 41, Clause 7.7.2

Insert the following paragraph at the end of clause 7.7.2:

In the Fast Slot Mode the Next_Slot command instructs all tags in the Round_Standby state to switch to the Active state.

Page 41, Clause 7.7.3

Replace clause 7.7.3 with the following text:

7.7.3 Standby_round

Command code = '04'

The Standby_round command has two functions:

- It acknowledges a valid response from a tag and instructs this tag to enter the Selected state if the tag supports the optional Selected state (individual commands can then be sent to this tag such as Read and Write), or

- It instructs all other tags in the Round_active state to enter the Round_standby state. For these tags, their participation in the round is suspended. tags that do not support the optional Selected state will move from the Round_active state to the Round_standby state irrespective of whether the Standby_round command acknowledged a valid response from the tag or not. The round will be resumed by a Next_slot command, or a Close_slot command. In addition, a new round will be initiated by tags in the Round_standby state by a New_round command, an Init_round command or an Init_round_all command.

The command contains:

The Standby_round command code, and

The tag signature.

No flags are used by this command.

Table 32 shows the Standby_round command format.

Table 32 — Standby_round command format

Protocol Extension	Standby _round	Tag signature	CRC-5
1 bit	6 bits	4 bits	5 bits

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Table 33 — Tag state transition for Standby_round

Command : Standby_round			
Current state	**Criteria**	**Action**	**New state**
Ready	None	None	Ready
Quiet	None	None	Quiet
Selected	None	None	Quiet
Round_active	Tag has answered in previous slot, AND Signature matches, AND Next_slot was received in the acknowledgement time window. See clause 7.5.5, AND Tag supports the optional SELECTED state.	None	Selected
	Tag has not answered in previous slot, OR Signature does not match OR Next_slot was not received in the acknowledgement time window. See clause 7.5.5, OR Tag does not support the optional SELECTED state.	None	Round_standby
Round_standby	None	None	Round_standby

Page 47, Clause 7.8.3

Insert the following paragraph after the first paragraph:

In the Fast Slot Mode the Close_Slot command instructs all tags in the Round_Standby state to switch to the Round_Active state.

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