

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Digital addressable lighting interface –
Part 208: Particular requirements for control gear – Switching function
(device type 7)**

**Interface d'éclairage adressable numérique –
Partie 208: Exigences particulières les pour appareillages de commande –
Fonction de commutation (dispositif de type 7)**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIGITAL ADDRESSABLE LIGHTING INTERFACE –**Part 208: Particular requirements for control gear –
Switching function (device type 7)**

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International Standard IEC 62386-208 has been prepared by subcommittee 34C: Auxiliaries for lamps, of IEC technical committee 34: Lamps and related equipment.

The text of this standard is based on the following documents:

CDV	Report on voting
34C/821/CDV	34C/842/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This Part 208 is intended to be used in conjunction with IEC 62386-101 and IEC 62386-102, which contain general requirements for the relevant product type (control gear or control devices).

A list of all parts of the IEC 62386 series, under the general title *Digital addressable lighting interface*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC website under <http://webstore.iec.ch> in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

This first edition of IEC 62386-208 is published in conjunction with IEC 62386-101 and IEC 62386-102. The division of IEC 62386 into separately published parts provides for ease of future amendments and revisions. Additional requirements will be added as and when a need for them is recognized.

This International Standard, and the other parts that make up the IEC 62386-200 series, in referring to any of the clauses of IEC 62386-101 or IEC 62386-102, specify the extent to which such a clause is applicable and the order in which the tests are to be performed. The parts also include additional requirements, as necessary. All parts that make up the IEC 62386-200 series are self-contained and therefore do not include references to each other.

Where the requirements of any of the clauses of IEC 62386-101 or IEC 62386-102 are referred to in this International Standard by the sentence "The requirements of IEC 62386-1XX, clause 'n' apply", this sentence is to be interpreted as meaning that all requirements of the clause in question of Part 101 or Part 102 apply, except any which are inapplicable to the specific type of lamp control gear covered by Part 208.

All numbers used in this International Standard are decimal numbers unless otherwise noted. Hexadecimal numbers are given in the format 0xVV, where VV is the value. Binary numbers are given in the format XXXXXXXXb or in the format XXXX XXXX, where X is 0 or 1; "x" in binary numbers means "don't care".

DIGITAL ADDRESSABLE LIGHTING INTERFACE –

Part 208: Particular requirements for control gear – Switching function (device type 7)

1 Scope

This International Standard specifies a protocol and test methods for the control by digital signals of electronic control gear that switches its output only on and off.

2 Normative references

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.

IEC 62386-101:2009, *Digital addressable lighting interface – Part 101: General requirements – System*

IEC 62386-102:2009, *Digital addressable lighting interface — Part 102: General requirements – Control gear*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in Clause 3 of IEC 62386-101:2009 and Clause 3 of IEC 62386-102:2009 shall apply, with the following additional definitions.

3.1

virtual arc power level

value calculated by the control gear during virtual dimming. It corresponds to the actual level of a dimmable control gear

3.2

virtual dimming

attribute of the control gear for treating arc power commands in the same way as a dimmable control gear. It provides virtual dimming by calculating a virtual arc power level in accordance with the appropriate fading definition, thus requiring the output state to change when the virtual arc power level reaches or passes a threshold

3.3

up switch-on threshold

value against which the virtual arc power level is continually compared, the output of the control gear being switched on whenever the virtual arc power level reaches or passes this level whilst increasing

3.4

up switch-off threshold

value against which the virtual arc power level is continually compared, the output of the control gear being switched off whenever the virtual arc power level reaches or passes this level whilst increasing

3.5

down switch-on threshold

value against which the virtual arc power level is continually compared, the output of the control gear being switched on whenever the virtual arc power level reaches or passes this level whilst decreasing

3.6

down switch-off threshold

value against which the virtual arc power level is continually compared, the output of the control gear being switched off whenever the virtual arc power level reaches or passes this level whilst decreasing

4 General description

The requirements of Clause 4 of IEC 62386-101:2009 and Clause 4 of IEC 62386-102:2009 shall apply.

5 Electrical specification

The requirements of Clause 5 of IEC 62386-101:2009 and Clause 5 of IEC 62386-102:2009 shall apply.

6 Interface power supply

The requirements of Clause 6 of IEC 62386-101:2009 and Clause 6 of IEC 62386-102:2009 shall apply if a power supply unit is integrated into the switching control gear.

7 Transmission protocol structure

The requirements of Clause 7 of IEC 62386-101:2009 and Clause 7 of IEC 62386-102:2009 shall apply.

8 Timing

The requirements of Clause 8 of IEC 62386-101:2009 and Clause 8 of IEC 62386-102:2009 shall apply.

9 Method of operation

The requirements of Clause 9 of IEC 62386-101:2009 and Clause 9 of IEC 62386-102:2009 shall apply with the following exceptions:

Amendments to Clause 9 of IEC 62386-102:2009:

9.2 Power-On

Addition:

If no command affecting power level is received before 0,6 s after mains power-on, the control gear shall set the virtual arc power level (VAPL) to the POWER-ON LEVEL immediately without fading.

In this case the VAPL shall be compared against the two up-threshold parameters to determine the output state. If the output state cannot be determined because the VAPL is below the thresholds, then the output shall be switched off, unless the UP Switch-On Threshold is set to "MASK", in which case the output shall be switched on.

If "MASK" is stored as the POWER ON LEVEL the VAPL shall be set to the last VAPL before mains power-down and the output state shall be determined according to the last threshold reached or passed (as indicated by bits 2 and 3 of the SWITCH STATUS byte).

9.3 Interface-failure

Addition:

If "MASK" is stored as SYSTEM FAILURE LEVEL, the control gear shall stay in the state it is in (no change of the virtual arc power level, no switching on or off). If any other value is stored, the control gear shall go to this virtual arc power level immediately without fading. On restoration of the idle voltage the control gear shall not change its state.

NOTE The actual output state will also depend on the dim direction. This has to be considered in some threshold configurations (e.g. switching hysteresis).

9.4 Min and max level

Addition:

The MIN LEVEL and the MAX LEVEL are used to define the range of virtual dimming:

The control gear shall check each received Arc Power Level against the MIN LEVEL and the MAX LEVEL before virtual dimming is performed.

Programming a MIN LEVEL above or a MAX LEVEL below the virtual arc power level shall set the virtual arc power level to the new MIN LEVEL or MAX LEVEL immediately without fading. If this causes the virtual arc power level to reach or pass a threshold, the output state shall change accordingly.

Programming a MIN LEVEL below or a MAX LEVEL above the virtual arc power level shall not be affecting the virtual arc power level.

Arc power levels stored in the control gear shall not be restricted by the MIN and MAX LEVEL settings. Nevertheless, those levels shall cause the virtual arc power level to be set to the MIN LEVEL or MAX LEVEL if the stored value is below the MIN LEVEL or above the MAX LEVEL.

The arc power levels "0" (OFF) and "255" (MASK) shall not be affected by the MIN and MAX LEVEL settings.

If the control gear does not support programmable thresholds the MIN LEVEL and the MAX LEVEL are fixed at the default values.

Additional subclause:

9.9 Switching characteristics

Different switching characteristics can be achieved by programming the parameters UP SWITCH-ON THRESHOLD, UP SWITCH-OFF THRESHOLD, DOWN SWITCH-ON THRESHOLD and DOWN SWITCH-OFF THRESHOLD.

The control gear shall continually compare the virtual arc power level (VAPL) against the four threshold parameters. The output shall be switched on or off in accordance with the result of the comparison and the current direction of dimming (see Table 1).

Table 1 – virtual arc power level (VAPL)

Dimming direction (virtual)	Result of comparison	Action
Up	$VAPL \geq \text{up switch-on threshold}$	Switch the output on
Up	$VAPL \geq \text{up switch-off threshold}$	Switch the output off
Down	$VAPL \leq \text{down switch-on threshold}$	Switch the output on
Down	$VAPL \leq \text{down switch-off threshold}$	Switch the output off

A threshold with the value 'MASK' shall not be used for the comparison.

If a pair of thresholds ("up-pair" or "down-pair") is programmed to the same value, switching on takes priority.

Programming a threshold shall not initiate a comparison and the output shall remain unchanged.

If the control gear does not support programmable thresholds, the thresholds are fixed at the default values.

Figure 1 gives an example of a possible configuration. More examples can be found in Annex A.

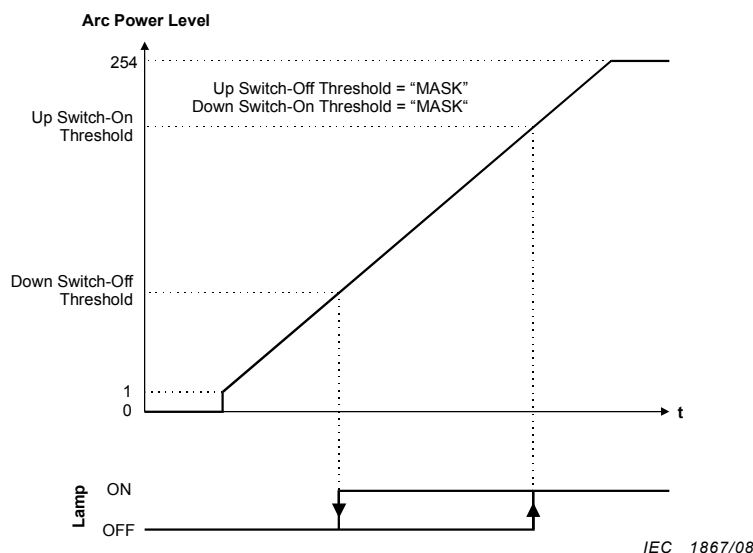


Figure 1 – Example of a possible configuration

10 Declaration of variables

The requirements of Clause 10 of IEC 62386-101:2009 and Clause 10 of IEC 62386-102:2009 shall apply, with the following adaptations and additional variables for this device type indicated in Table 2:

Table 2 – Declaration of variables

Variable	Default value (control gear leaves the factory)	Reset value	Range of validity	Memory ^a
"PHYSICAL MIN. LEVEL"	254	No change	254	1 byte ROM
"MIN LEVEL"	254	254	1 – MAX LEVEL	1 byte
"MAX LEVEL"	254	254	MIN LEVEL – 254	1 byte
"UP SWITCH-ON THRESHOLD"	1	1	1 – 254, 255 ('MASK')	1 byte
"UP SWITCH-OFF THRESHOLD"	255	255	1 – 254, 255 ('MASK')	1 byte
"DOWN SWITCH-ON THRESHOLD"	255	255	0 – 254, 255 ('MASK')	1 byte
"DOWN SWITCH-OFF THRESHOLD"	0	0	0 – 254, 255 ('MASK')	1 byte
"ERROR HOLD-OFF TIME"	0	0	0 – 255	1 byte
"FEATURES"	Factory burn-in	No change	0 – 255	1 byte ROM
"GEAR TYPE"	Factory burn-in	No change	0 – 255	1 byte ROM
"SWITCH STATUS"	U000 0UUU ^b	No change	0 – 255	1 byte RAM ^c
U = undefined ^a Persistent memory (storage time indefinite) if not stated otherwise. ^b Power up value ^c Bits 2, 3 and 7 of this byte shall be stored in the persistent memory				

11 Definition of commands

The requirements of Clause 11 of IEC 62386-101:2009 and Clause 11 of IEC 62386-102:2009, shall apply with the following exceptions:

11.1 Arc power control commands

Addition:

For all arc power control commands the following rule applies: Actual Arc Power Level = virtual arc power level.

A received arc power control command shall affect the virtual arc power level.

Whenever the definition of an arc power control command requires the lamp (load) to be switched off, the virtual arc power level shall be set to 0. If the virtual arc power level is 0 and command 8 "ON AND STEP UP" is received, the virtual arc power level shall be set to MIN LEVEL.

The Actual Arc Power Level (and so the output state) shall only change when the virtual arc power level reaches, passes or leaves a threshold.

11.2.1 General configuration commands

Amendment:

Command 33: YAAA AAA1 0010 0001 "STORE ACTUAL LEVEL IN THE DTR"

Store virtual arc power level in the DTR.

11.3.1 Queries related to status information*Amendment***Command 144: YAAA AAA1 1001 0000 "QUERY STATUS"**

Bit 4 "Fade running" shall be set during a virtual dimming process.

Command 153: YAAA AAA1 1001 1001 "QUERY DEVICE TYPE"

The answer shall be 7.

11.3.2 Queries related to arc power parameter settings*Amendment:***Command 160: YAAA AAA1 1010 0000 "QUERY ACTUAL LEVEL"**

The answer shall be "0" if the load is switched off or "254" if the load is switched on. During preheating (if applicable) or if a load error is detected the answer shall be "MASK".

11.3.4 Application extended commands*Replacement:*

Application extended commands shall be preceded by command 272 'ENABLE DEVICE TYPE 7'.

NOTE For device types other than 7, these commands may be used in a different way.

A switching control gear with only switching function shall not react to application extended commands preceded by command 272 'ENABLE DEVICE TYPE X' with $X \neq 7$.

11.3.4.1 Application extended configuration commands

Every configuration command (224 – 239) shall be received a second time within 100 ms (nominal) before it is executed in order to reduce the probability of incorrect reception. No other commands addressing the same control gear shall be sent between these two commands, otherwise the first such command shall be ignored and the respective configuration sequence aborted.

Command 272 must be sent before the two instances of the respective configuration command, but not repeated between them (see Figure 2).

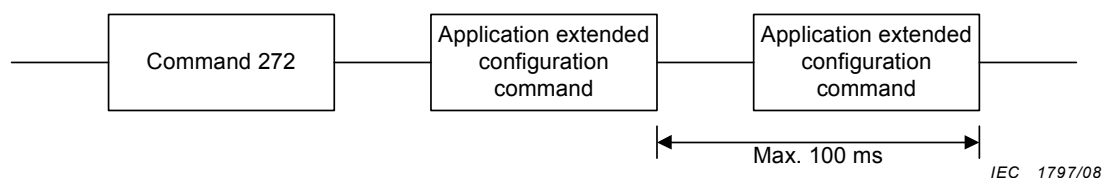


Figure 2 – Application extended configuration command sequence example

All values of DTR shall be checked against the values mentioned in Clause 10, RANGE OF VALIDITY, i.e. the value shall be set to the upper / lower limit if it is above / below the valid range defined in Clause 10.

Command 224: YAAA AAA1 1110 0000 'REFERENCE SYSTEM POWER'

The switching control gear shall measure and store the system power level in order to detect load errors. The measured power level shall be stored in the persistent memory. Commands received during the measuring period shall be ignored except query commands and command 256.

After 15 min at most the switching control gear shall finish the measurement process and shall go back to normal operation. The measurement process shall be aborted if command 256 'TERMINATE' is received.

When there has been no successful reference measurement or the most recent reference measurement was unsuccessful, bit 7, reference measurement failed, in the answer to command 240 'QUERY FAILURE STATUS' shall be set and command 249 'QUERY REFERENCE MEASUREMENT FAILED' shall be answered with 'Yes'.

This is an optional feature. Control gear without this feature shall not react (see command 240) and bit 7 in the FAILURE STATUS shall be always being zero.

Command 225: YAAA AAA1 1110 0001 'STORE DTR AS UP SWITCH-ON THRESHOLD'

Store the content of the DTR as new UP SWITCH-ON THRESHOLD.

If 255 ('MASK') is stored, the threshold shall not be used for comparison.

This is an optional feature. Switching control gear without this feature shall not react.

Command 226: YAAA AAA1 1110 0010 'STORE DTR AS UP SWITCH-OFF THRESHOLD'

Store the content of the DTR as new UP SWITCH-OFF THRESHOLD.

If 255 ('MASK') is stored, the threshold shall not be used for comparison.

This is an optional feature. Switching control gear without this feature shall not react.

Command 227: YAAA AAA1 1110 0011 'STORE DTR AS DOWN SWITCH-ON THRESHOLD'

Store the content of the DTR as new DOWN SWITCH-ON THRESHOLD.

If 255 ('MASK') is stored, the threshold shall not be used for comparison.

This is an optional feature. Switching control gear without this feature shall not react.

Command 228: YAAA AAA1 1110 0100 'STORE DTR AS DOWN SWITCH-OFF THRESHOLD'

Store the content of the DTR as new DOWN SWITCH-OFF THRESHOLD.

If 255 ('MASK') is stored, the threshold shall not be used for comparison.

This is an optional feature. Switching control gear without this feature shall not react.

Command 229: YAAA AAA1 1110 0101 'STORE DTR AS ERROR HOLD-OFF TIME'

Store the content of the DTR as new ERROR HOLD-OFF TIME value in units of 10 s.

The ERROR HOLD-OFF TIME specifies the minimum time an error must be continuously present in order to be indicated.

If 0 is stored, a load error shall be indicated immediately.

If 255 ('MASK') is stored, a load error shall not be indicated.

This is an optional feature. Switching control gear without this feature shall not react.

Commands 230 – 231: YAAA AAA1 1110 011X

Reserved for future needs. The switching control gear must not react in any way.

Commands 232 – 239: YAAA AAA1 1110 1XXX

Reserved for future needs. The switching control gear must not react in any way.

11.3.4.2 Application extended query commands

Command 240: YAAA AAA1 1111 0000 'QUERY FEATURES'

The answer shall be the following FEATURES byte indicating the features supported by the switching control gear.

bit 0	load error can be queried;	'0' = No
bit 1	unused;	'0' = default value
bit 2	unused;	'0' = default value
bit 3	adjustable thresholds;	'0' = No
bit 4	adjustable hold-off time;	'0' = No
bit 5	unused;	'0' = default value
bit 6	Reference system power supported;	'0' = No
bit 7	physical selection supported;	'0' = No

Bit 3: If this bit is set, commands 225 – 228, command 42 'STORE DTR AS MAX LEVEL' and command 43 'STORE DTR AS MIN LEVEL' are mandatory.

Bit 4: If this bit is set, command 231 'STORE DTR AS ERROR HOLD-OFF TIME' is mandatory.

Bit 6: If this bit is set, command 224 'REFERENCE SYSTEM POWER', command 249 'QUERY REFERENCE RUNNING' and command 250 'QUERY REFERENCE MEASUREMENT FAILED' are mandatory.

Command 241: YAAA AAA1 1111 0001 'QUERY SWITCH STATUS'

The answer shall be the following 'SWITCH STATUS' byte:

bit 0	load error detected;	'0' = No
bit 1	error detection in hold-off;	'0' = No
bit 2-3	last threshold acted upon	'00' = Up Switch-On
	'01' = Up Switch-Off	
	'10' = Down Switch-On	
	'11' = Down Switch-Off	
bit 4	unused;	'0' = default value
bit 5	unused;	'0' = default value
bit 6	unused;	'0' = default value
bit 7	reference measurement failed;	'0' = No

The 'SWITCH STATUS' shall be available in the RAM of the switching control gear and shall be updated regularly by the switching control gear according to the actual situation.

If bit 0 is set the answer of command 146 'QUERY LAMP FAILURE' shall be 'Yes' and bit 1 in the answer of command 144 'QUERY STATUS' shall be set.

Bits 2 and 3 shall be stored in the persistent memory.

Bit 7 shall be set if the reference measurement of the system power failed for any reason. It shall be stored in the persistent memory. If bit 6 is zero (meaning reference measurement is not supported) this bit shall also be zero.

Command 242: **YAAA AAA1 1111 0010** **'QUERY UP SWITCH-ON THRESHOLD'**

The answer shall be the UP SWITCH-ON THRESHOLD level as an 8-bit number.

Command 243: **YAAA AAA1 1111 0011** **'QUERY UP SWITCH-OFF THRESHOLD'**

The answer shall be the UP SWITCH-OFF THRESHOLD level as an 8-bit number.

Command 244: **YAAA AAA1 1111 0100** **'QUERY DOWN SWITCH-ON THRESHOLD'**

The answer shall be the DOWN SWITCH-ON THRESHOLD level as an 8-bit number.

Command 245: **YAAA AAA1 1111 0101** **'QUERY DOWN SWITCH-OFF THRESHOLD'**

The answer shall be the DOWN SWITCH-OFF THRESHOLD level as an 8-bit number.

Command 246: **YAAA AAA1 1111 0110** **'QUERY ERROR HOLD-OFF TIME'**

The answer shall be the ERROR HOLD-OFF TIME as an 8-bit number.

Command 247: **YAAA AAA1 1111 0111** **'QUERY GEAR TYPE'**

The answer shall be the following GEAR TYPE byte:

bit 0	output is an electronic switch;	'0' = No
bit 1	output is a relay with default open contacts	'0' = No
bit 2	output is a relay with default closed contacts	'0' = No
bit 3	output has a transient suppressor;	'0' = No
bit 4	load inrush current limitation is integrated;	'0' = No
bit 5	unused;	'0' = default value
bit 6	unused;	'0' = default value
bit 7	unused;	'0' = default value

If bit 1 and 2 are both set, the output is of the latching type. The latched state does not change when power is removed.

Command 248: **YAAA AAA1 1111 1000**

Reserved for future needs. The switching control gear must not react in any way.

Command 249: **YAAA AAA1 1111 1001** **"QUERY REFERENCE RUNNING"**

Ask if there is the REFERENCE SYSTEM POWER measurement running at the given address. The answer shall be 'Yes' or 'No'.

Switching control gear without this feature shall not react (see command 240).

Command 250: **YAAA AAA1 1111 1010** **'QUERY REFERENCE MEASUREMENT FAILED'**

Ask if the reference measurement started by command 224 'REFERENCE SYSTEM POWER' failed at the given address. The answer shall be 'Yes' or 'No'.

Switching control gear without this feature shall not react (see command 240).

Command 251: YAAA AAA1 1111 1011

Reserved for future needs. The switching control gear must not react in any way.

Commands 252 – 253: YAAA AAA1 1111 110X

Reserved for future needs. The switching control gear must not react in any way.

Command 254: YAAA AAA1 1111 1110

Reserved for future needs. The switching control gear must not react in any way.

Command 255: YAAA AAA1 1111 1111 “QUERY EXTENDED VERSION NUMBER”

The answer shall be 1.

11.4.4 Extended special commands

Amendment:

Command 272: 1100 0001 0000 0111 “ENABLE DEVICE TYPE 7”

The device type for control gear with switching function is 7.

11.5 Summary of the command set

The commands listed in IEC 62386-101:2009 and 11.5 of IEC 62386-102: 2009 shall apply with the following additional commands for device type 7 shown in Table 3.

Table 3 – Summary of the application extended command set

Command Number	Command Code	Command Name
224	YAAA AAA1 1110 0000	REFERENCE SYSTEM POWER
225	YAAA AAA1 1110 0001	STORE DTR AS UP SWITCH-ON THRESHOLD
226	YAAA AAA1 1110 0010	STORE DTR AS UP SWITCH-OFF THRESHOLD
227	YAAA AAA1 1110 0011	STORE DTR AS DOWN SWITCH-ON THRESHOLD
228	YAAA AAA1 1110 0100	STORE DTR AS DOWN SWITCH-OFF THRESHOLD
229	YAAA AAA1 1110 0101	STORE DTR AS ERROR HOLD-OFF TIME
230 – 231	YAAA AAA1 1110 011X	^a
232 – 239	YAAA AAA1 1110 1XXX	^a
240	YAAA AAA1 1111 0000	QUERY FEATURES
241	YAAA AAA1 1111 0001	QUERY SWITCH STATUS
242	YAAA AAA1 1111 0010	QUERY UP SWITCH-ON THRESHOLD
243	YAAA AAA1 1111 0011	QUERY UP SWITCH-OFF THRESHOLD
244	YAAA AAA1 1111 0100	QUERY DOWN SWITCH-ON THRESHOLD
245	YAAA AAA1 1111 0101	QUERY DOWN SWITCH-OFF THRESHOLD
246	YAAA AAA1 1111 0110	QUERY ERROR HOLD-OFF TIME
247	YAAA AAA1 1111 0111	QUERY GEAR TYPE
248	YAAA AAA1 1111 1000	^a
249	YAAA AAA1 1111 1001	QUERY REFERENCE RUNNING
250	YAAA AAA1 1111 1010	QUERY REFERENCE MEASUREMENT FAILED
251	YAAA AAA1 1111 1011	^a
252 – 253	YAAA AAA1 1111 110X	^a
254	YAAA AAA1 1111 1110	^a
255	YAAA AAA1 1111 1111	QUERY EXTENDED VERSION NUMBER
272	1100 0001 0000 0111	ENABLE DEVICE TYPE 7
^a Reserved for future needs. The switching control gear shall not react in any way.		

12 Test procedures

The requirements of Clause 12 of IEC 62386-102:2009 shall apply with the following exceptions:

12.3 Test sequences 'Arc power control commands'

Amendment:

Arc power control commands shall be tested as defined below in 12.7.4. Therefore the test sequences defined in IEC 62386-102:2009, subclause 12.3. shall not apply.

12.4 Test sequence 'Physical address allocation'

Amendment:

Physical selection is an optional feature of switching control gear. Therefore this test sequence is not mandatory.

Additional subclause:

12.7 Test sequences 'APPLICATION EXTENDED COMMANDS FOR DEVICE TYPE 7'

The application extended commands defined for switching control gear (device type 7) are tested using the following test sequences. The sequences also check for possible reaction to the commands for other device types.

12.7.1 Test sequence 'APPLICATION EXTENDED QUERY COMMANDS'

The following test sequences check the application extended query commands 238 to 250.

12.7.1.1 Test sequence 'QUERY FEATURES'

Command 240 'QUERY FEATURES' and command 272 'ENABLE DEVICE TYPE 7', as well as command 154 'QUERY PHYSICAL MINIMUM' are tested. The test sequence is shown in Figure 3.

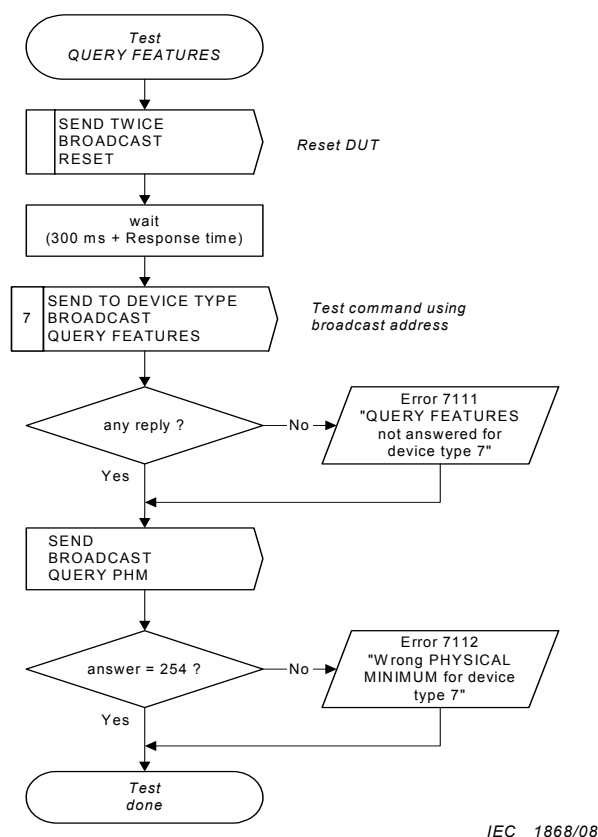
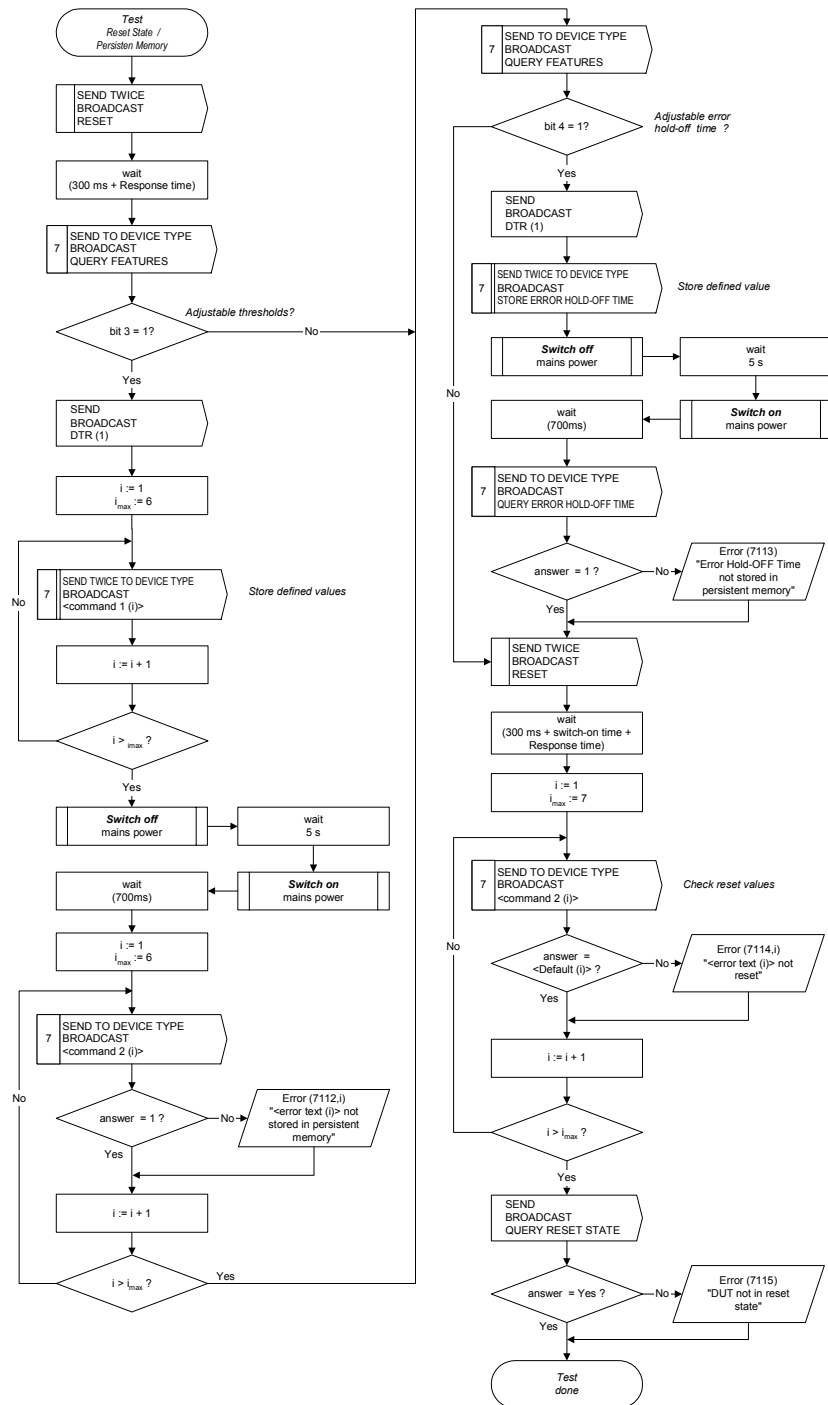


Figure 3 – Test sequence QUERY FEATURES

12.7.1.2 Test sequence 'Reset State / Persistent Memory'

In this test sequence all application extended user programmable parameters are set to non-reset values. After sending a RESET command the parameters are checked for their reset values. Furthermore the persistent memory of the DUT is tested for these parameters. The test sequence is shown in Figure 4 and the parameters in Table 4.



IEC 1869/08

Figure 4 – Test sequence Reset State / Persistent Memory

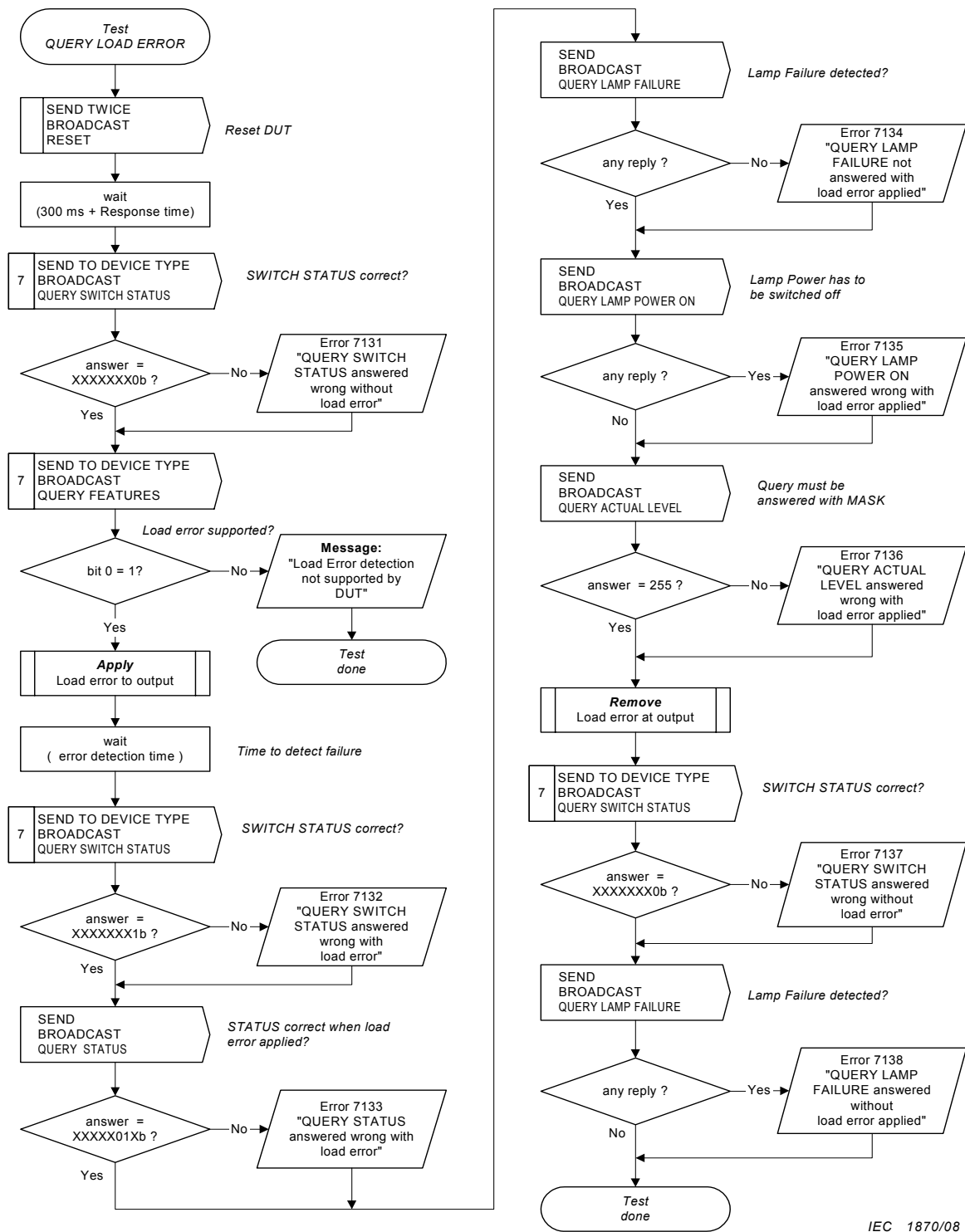
Table 4 – Parameters for the test sequence State / Persistent Memory

i	<command 1 (i)>	<command 2 (i)>	<Default (i)>	<error text (k)>
1	STORE DTR AS UP SWITCH-ON THRESHOLD	QUERY UP SWITCH-ON THRESHOLD	1	UP SWITCH-ON THRESHOLD
2	STORE DTR AS UP SWITCH-OFF THRESHOLD	QUERY UP SWITCH-OFF THRESHOLD	255	UP SWITCH-OFF THRESHOLD
3	STORE DTR AS DOWN SWITCH-ON THRESHOLD	QUERY DOWN SWITCH-ON THRESHOLD	255	DOWN SWITCH-ON THRESHOLD
4	STORE DTR AS DOWN SWITCH-OFF THRESHOLD	QUERY DOWN SWITCH-OFF THRESHOLD	255	DOWN SWITCH-OFF THRESHOLD
5	STORE DTR MIN LEVEL	QUERY MIN LEVEL	254	MIN LEVEL
6	STORE DTR MAX LEVEL	QUERY MAX LEVEL	254	MAX LEVEL
7	STORE DTR AS ERROR HOLD-OFF TIME	QUERY ERROR HOLD-OFF TIME	0	ERROR HOLD-OFF TIME

12.7.1.3 Test sequence 'QUERY LOAD ERROR'

Bit 1 of the answer of command 241 'QUERY SWITCH STATUS' and the correct answers of command 144 'QUERY STATUS', command 146 'QUERY LAMP FAILURE', command 147 'QUERY LAMP POWER ON' and command 160 'QUERY ACTUAL LEVEL' are tested. The test sequence is shown in Figure 5.

The parameter <error detection time> which is used in this test sequence, has to be specified by the manufacturer.

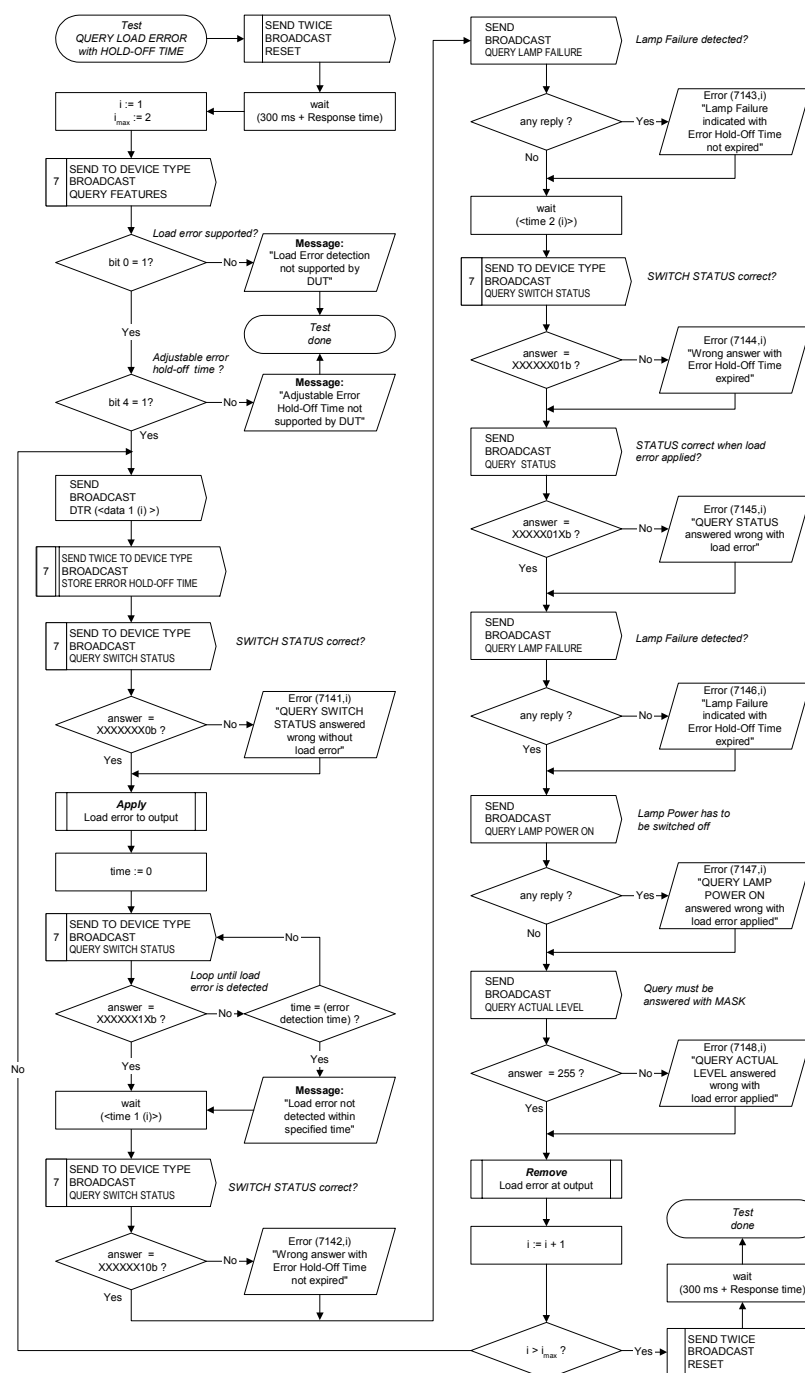


IEC 1870/08

Figure 5 – Test sequence QUERY LOAD ERROR

12.7.1.4 Test sequence 'QUERY LOAD ERROR with HOLD-OFF TIME'

The correct status indication is tested with an Error Hold-Off Time of 10 s and 20 s. The parameter <error detection time> which is used in this test sequence, has to be specified by the manufacturer. The test sequence is shown in Figure 6 and the test steps in Table 5.



IEC 1871/08

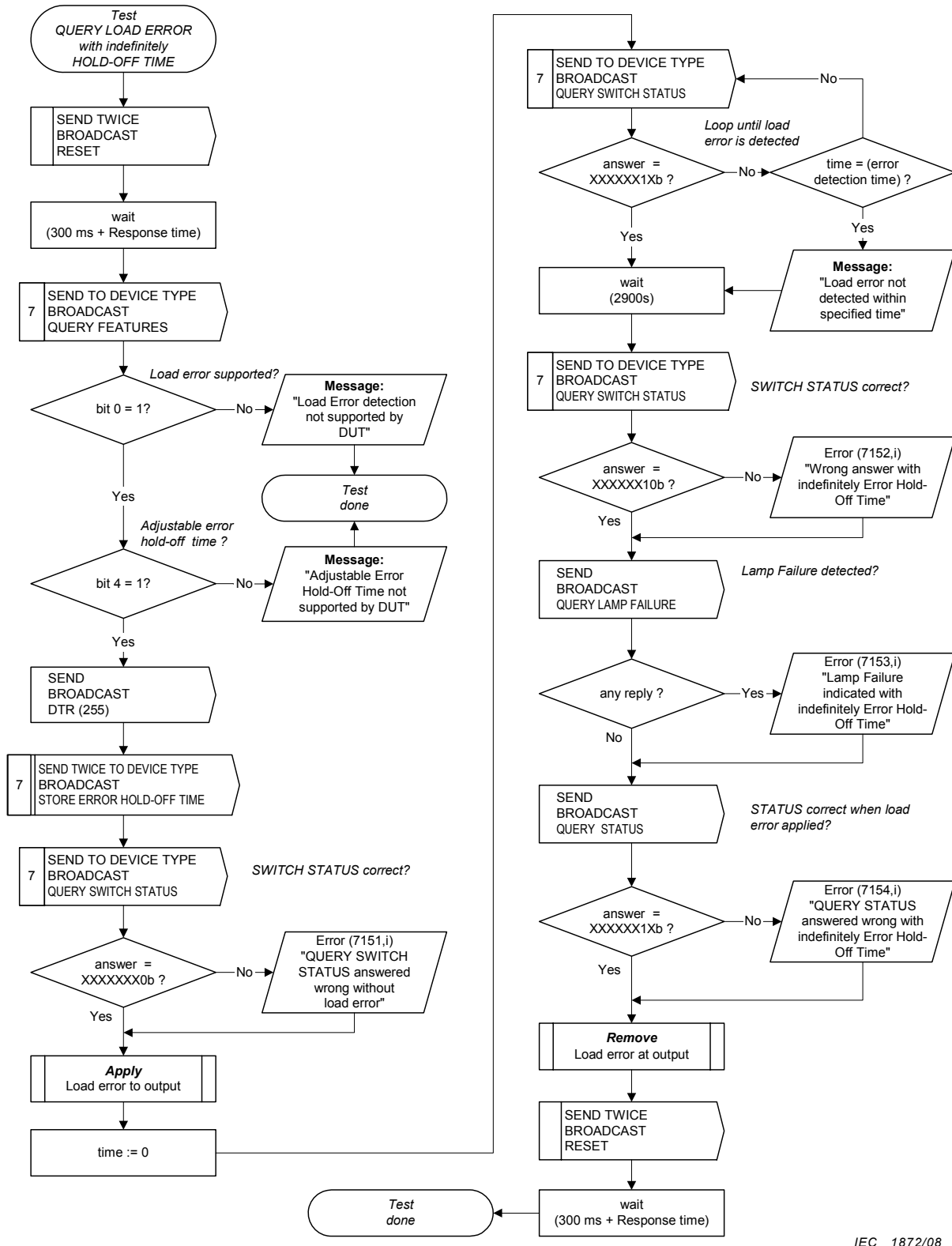
Figure 6 – Test sequence QUERY LOAD ERROR with HOLD-OFF TIME

Table 5 – Test step QUERY LOAD ERROR with HOLD-OFF TIME

Test step (<i>i</i>)	< data 1 (<i>i</i>) >	< time 1(<i>i</i>) >	< time 2(<i>i</i>) >
1	1	8s	4s
2	2	16s	8s

12.7.1.5 Test sequence 'QUERY LOAD ERROR with indefinitely HOLD-OFF TIME'

The correct status indication is tested with an indefinitely Error Hold-Off Time. The parameter <error detection time> which is used in this test sequence, has to be specified by the manufacturer. The test sequence is shown in Figure 7.



IEC 1872/08

Figure 7 – Test sequence QUERY LOAD ERROR with indefinitely HOLD-OFF TIME

12.7.1.6 Test sequence 'QUERY Control Gear Information'

Command 247 'QUERY GEAR TYPE' is tested and the information about the control gear has to be reported. The test sequence is shown in Figure 8.

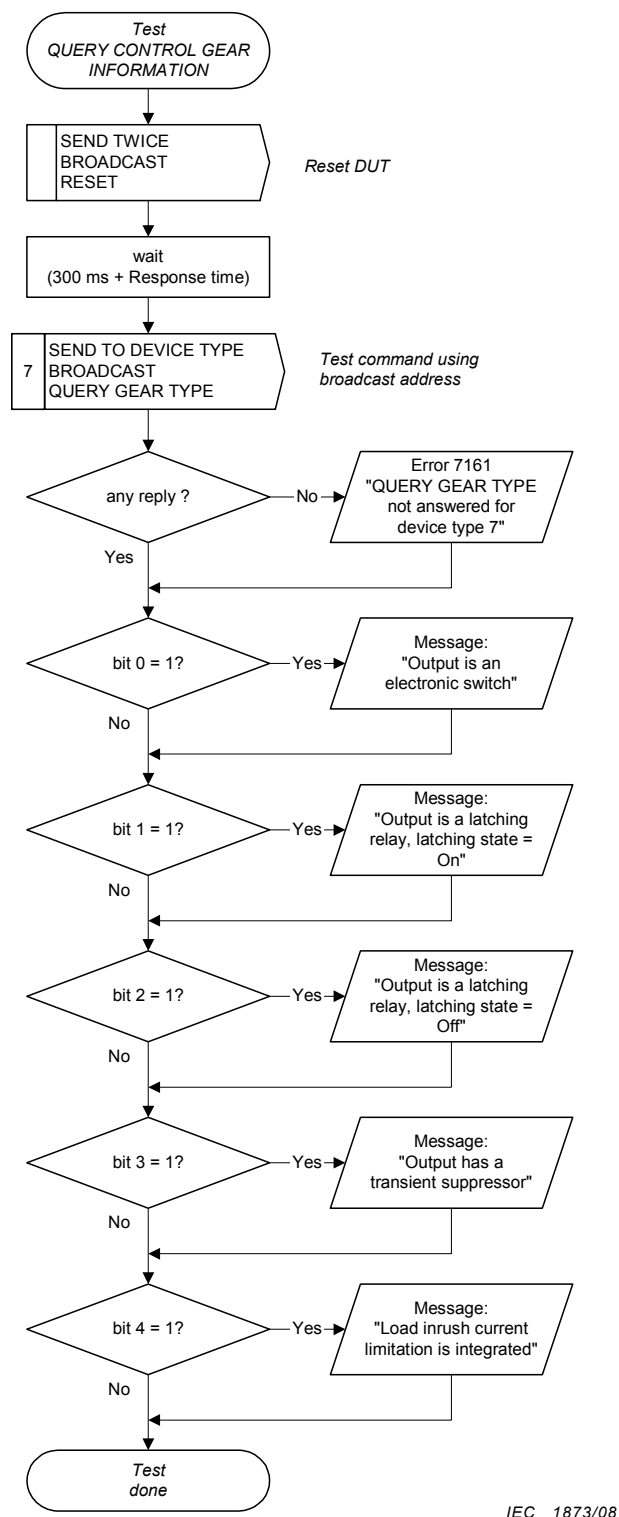


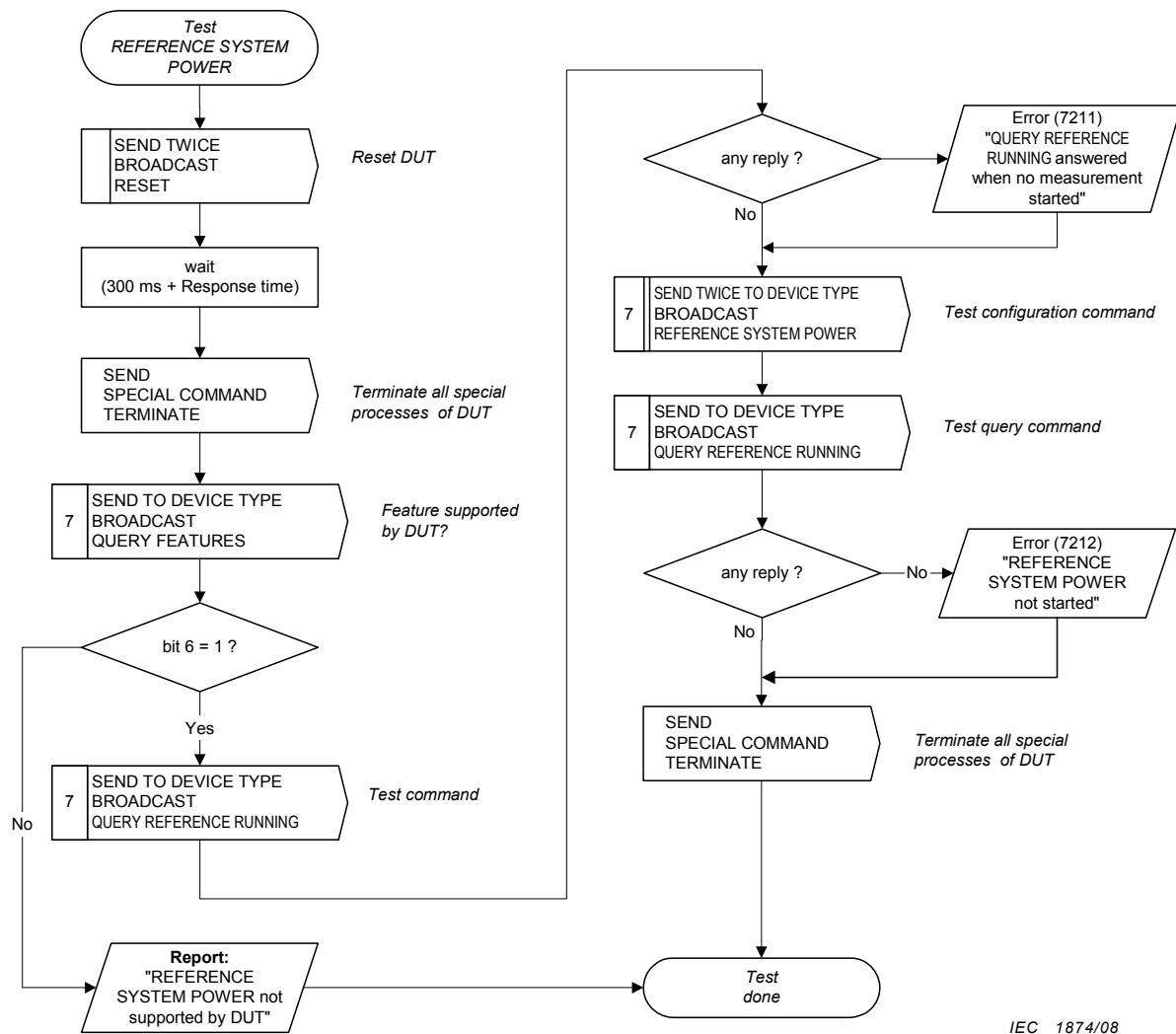
Figure 8 – Test sequence QUERY Control Gear Information

12.7.2 Test sequences 'APPLICATION EXTENDED CONFIGURATION COMMANDS'

The following test sequences check the application extended configuration commands 224 to 231.

12.7.2.1 Test sequence 'REFERENCE SYSTEM POWER'

Command 224 'REFERENCE SYSTEM POWER' as well as command 249 'QUERY REFERENCE RUNNING' is tested using different device types. The test sequence is shown in Figure 9.



IEC 1874/08

Figure 9 – Test sequence REFERENCE SYSTEM POWER

12.7.2.2 Test sequence 'REFERENCE SYSTEM POWER: 100 ms-timeout'

In this sequence the reference measurement is tried to be started with the configuration command 224 'REFERENCE SYSTEM POWER' sent twice with a timeout of 150 ms. It is also checked if command 256 'TERMINATE' stops the reference measurement. The test sequence is shown in Figure 10.

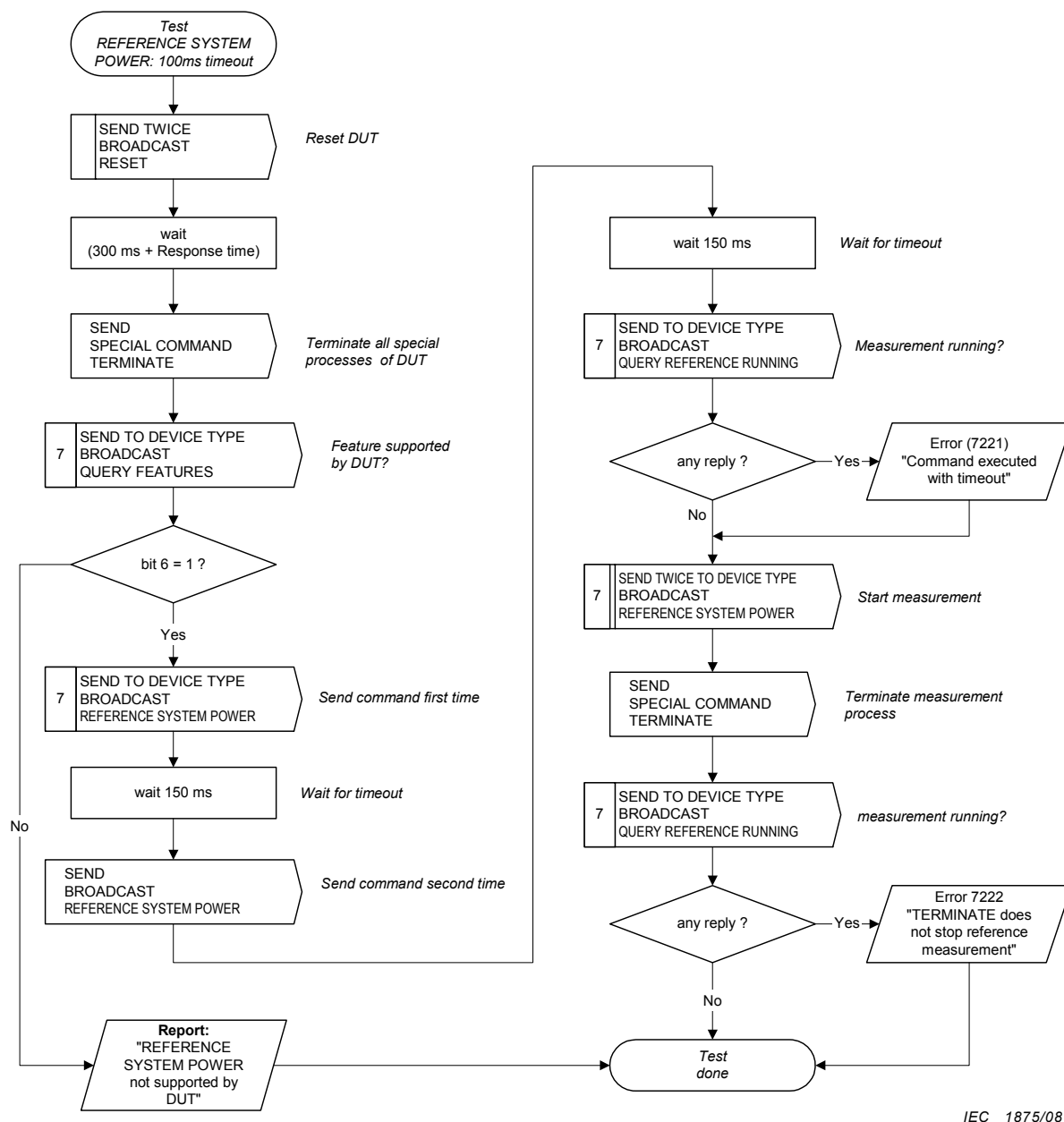
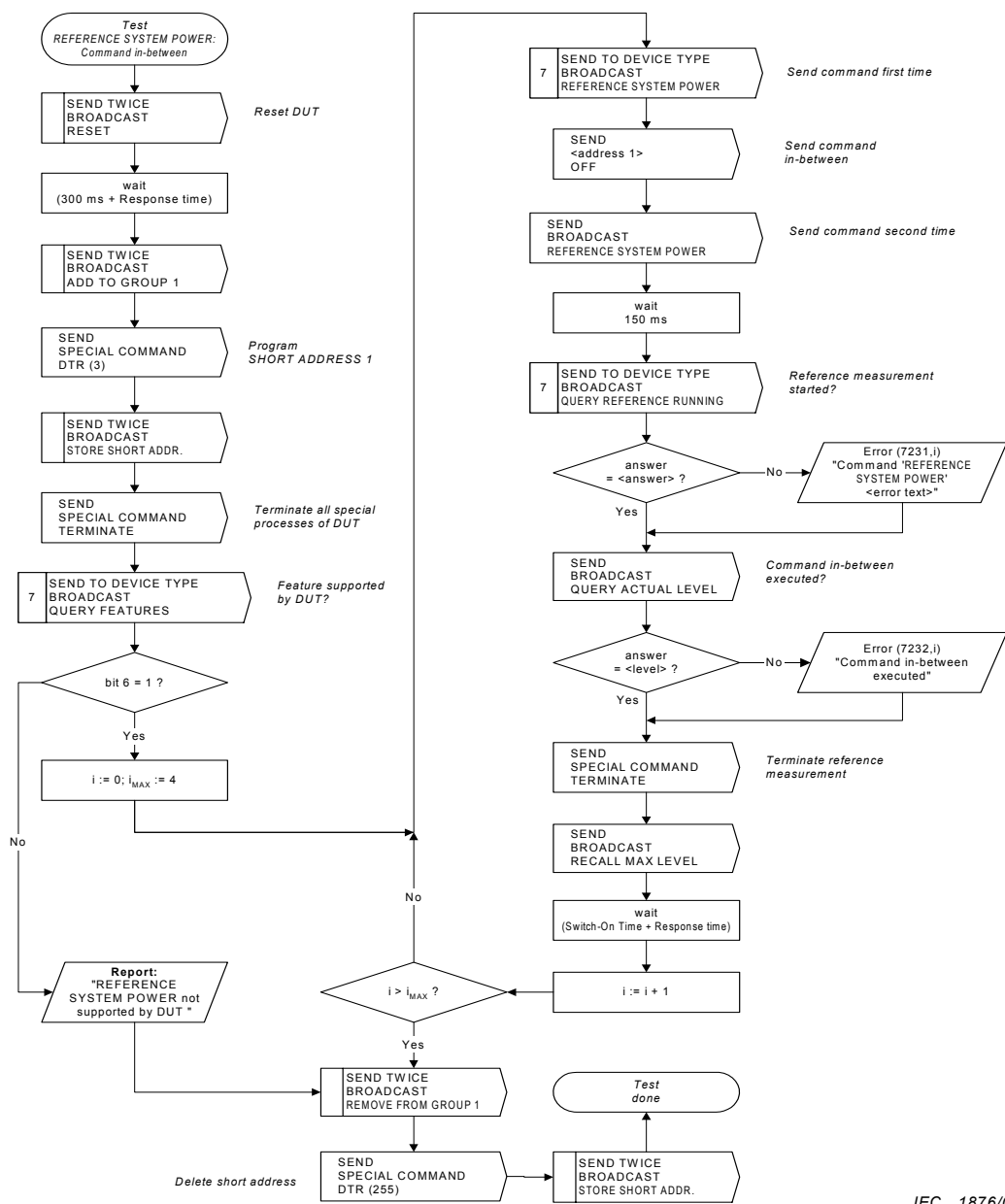


Figure 10 – Test sequence REFERENCE SYSTEM POWER: 100 ms-timeout

12.7.2.3 Test sequence 'REFERENCE SYSTEM POWER: Command in-between'

In this sequence the reference measurement is tried to be started with commands in-between the two commands 224 'REFERENCE SYSTEM POWER'. The two commands 224 and the command in-between are to be sent within 100 ms. The test sequence is shown in Figure 11 and the test steps in Table 6.



IEC 1876/08

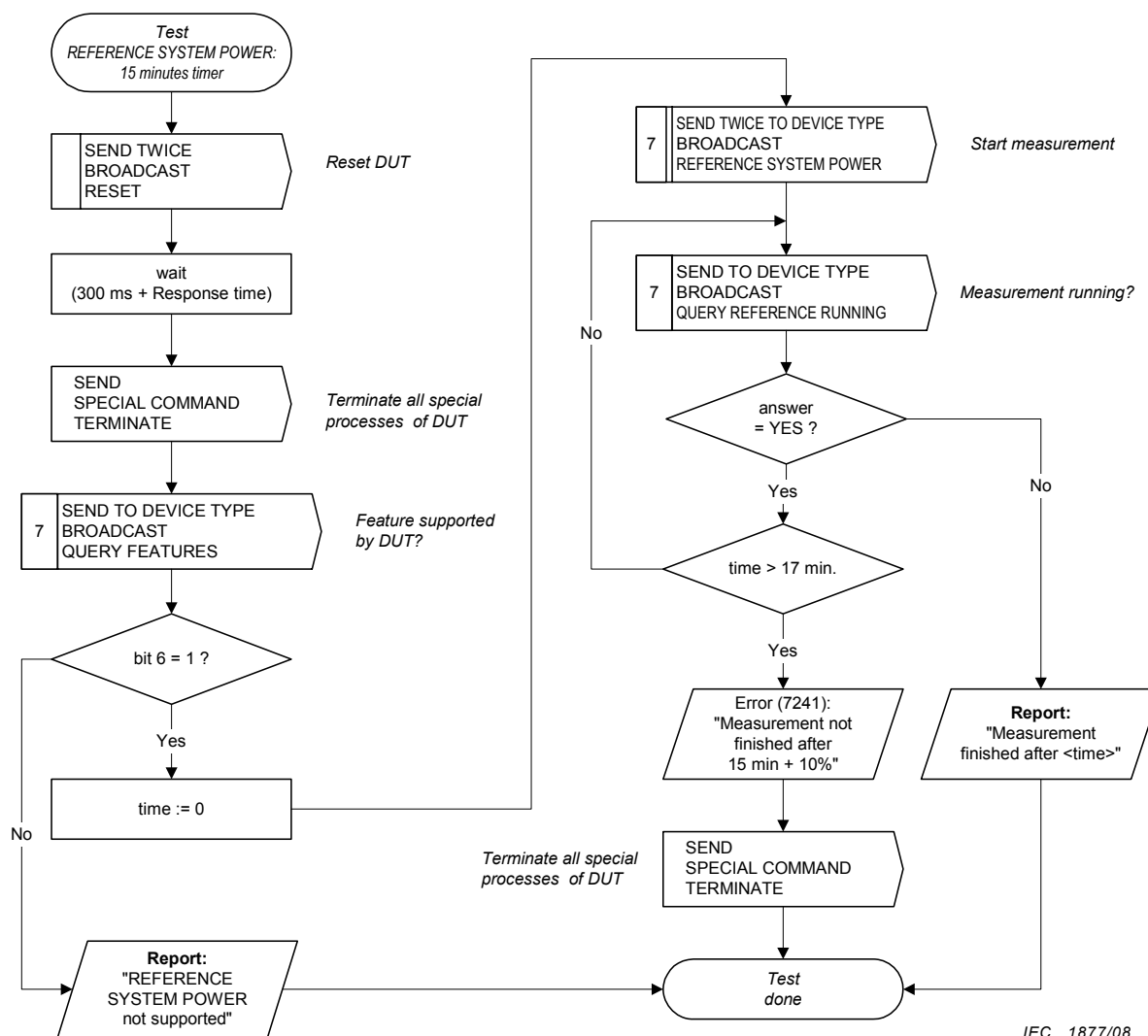
Figure 11 – Test sequence REFERENCE SYSTEM POWER: Command in-between

Table 6 – Test steps REFERENCE SYSTEM POWER: Command in-between

i	<address 1>	<answer>	<level>	<error text>
0	Short Address 1	'No'	254	executed
1	GROUP 1	'No'	254	executed
2	BROADCAST	'No'	254	executed
3	Short Address 2	'Yes'	≠ 0	not executed
4	GROUP 2	'Yes'	≠ 0	not executed

12.7.2.4 Test sequence 'REFERENCE SYSTEM POWER: 15 min timer'

Not later than 15 min after receiving command 224 'REFERENCE SYSTEM POWER' the measurement has to be finished and the converter has to return to normal operation. The test sequence is shown in Figure 12.



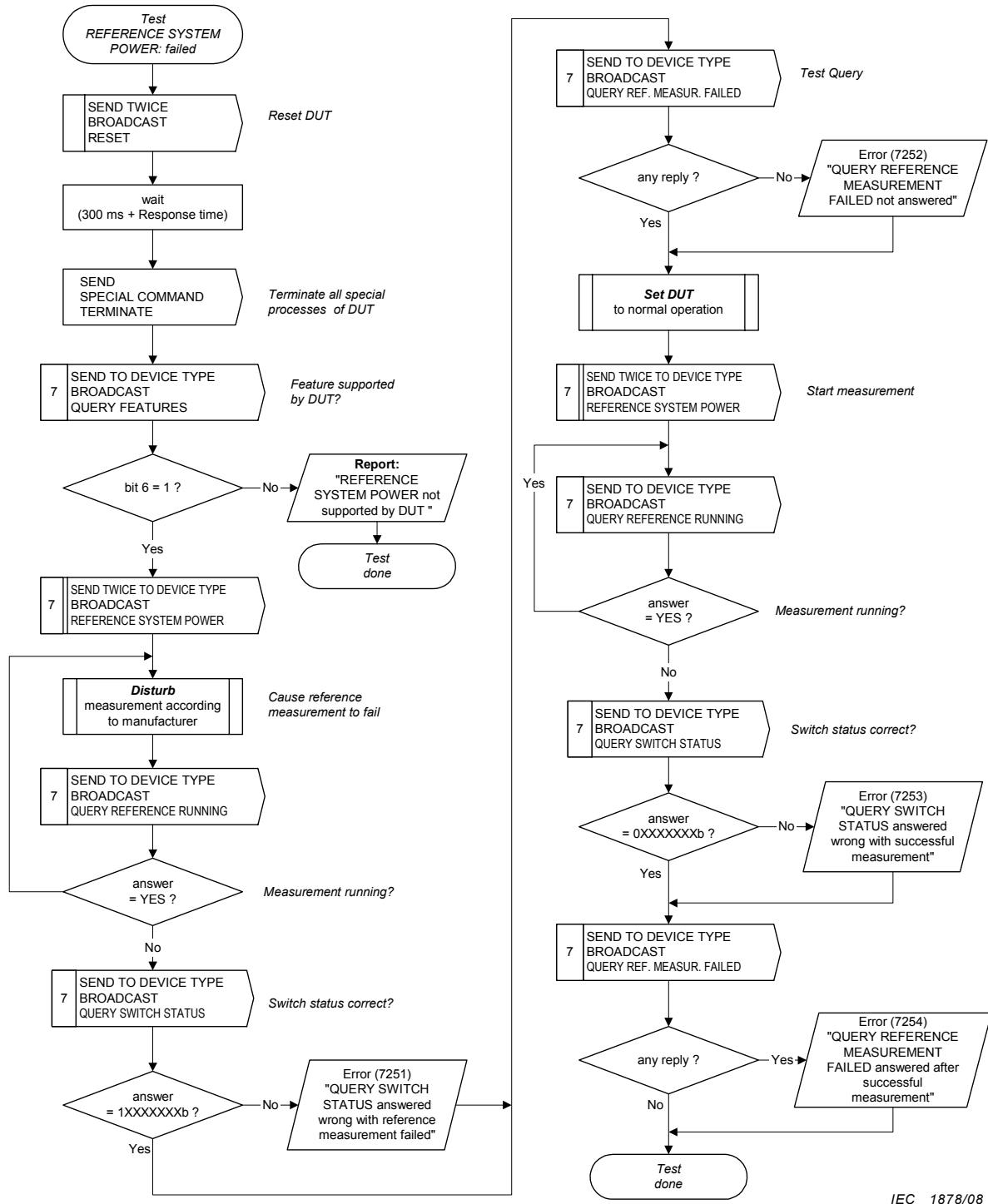
IEC 1877/08

Figure 12 – Test sequence REFERENCE SYSTEM POWER: 15 min timer

12.7.2.5 Test sequence 'REFERENCE SYSTEM POWER: failed'

Bit 7 in the answer of command 241 'QUERY SWITCH STATUS' and command 250 'QUERY REFERENCE MEASUREMENT FAILED' is tested in accordance with the test sequence shown in Figure 13.

The reference measurement is caused to fail by e.g. undervoltage. The way to cause the measurement to fail shall be stated by the manufacturer of the DUT.

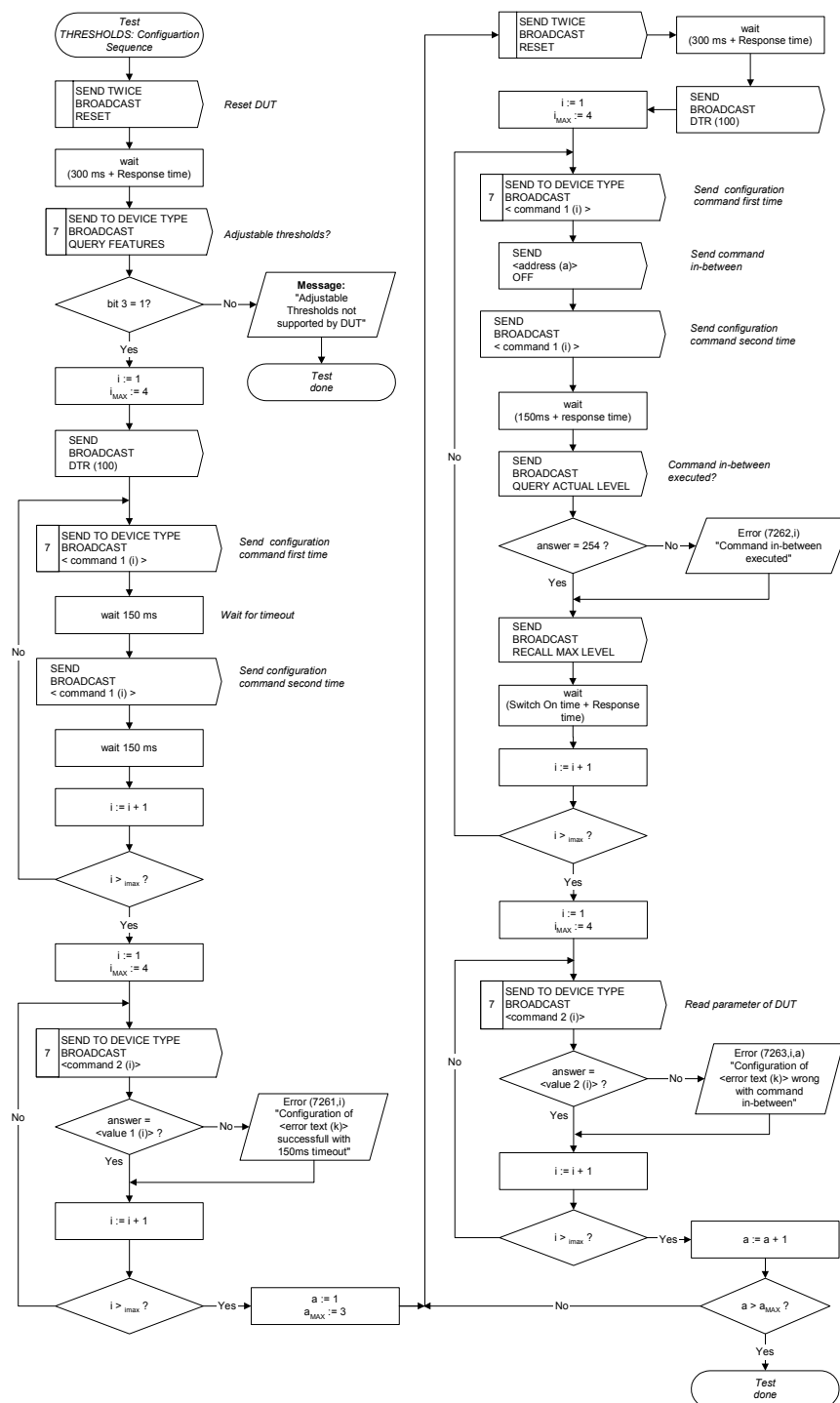


IEC 1878/08

Figure 13 – Test sequence REFERENCE SYSTEM POWER: failed

12.7.2.6 Test sequence 'THRESHOLDS: Configuration Sequence'

In this sequence the four thresholds are tried to be changed with the appropriate configuration command sent twice with a timeout of 150 ms as well as with commands in-between the two appropriate configuration commands. The two appropriate configuration commands and the command in-between are to be sent within 100 ms. The test sequence is shown in Figure 14 and the parameters in Tables 7, 8 and 9.



IEC 1879/08

Figure 14 – Test sequence THRESHOLDS: Configuration Sequence

Table 7 – Test parameter and test steps 1 THRESHOLDS: Configuration Sequence

i	<command 1 (i)>	<command 2 (i)>
1	STORE DTR AS UP SWITCH-ON THRESHOLD	QUERY UP SWITCH-ON THRESHOLD
2	STORE DTR AS UP SWITCH-OFF THRESHOLD	QUERY UP SWITCH-OFF THRESHOLD
3	STORE DTR AS DOWN SWITCH-ON THRESHOLD	QUERY DOWN SWITCH-ON THRESHOLD
4	STORE DTR AS DOWN SWITCH-OFF THRESHOLD	QUERY DOWN SWITCH-OFF THRESHOLD

Table 8 – Test parameter and test steps 2 THRESHOLDS: Configuration Sequence

i	<value 1 (i)>	<value 2 (i)>		<error text (i)>
		a = 1	a ≠ 1	
1	1	1	100	UP SWITCH-ON THRESHOLD
2	255	255	100	UP SWITCH-OFF THRESHOLD
3	255	255	100	DOWN SWITCH-ON THRESHOLD
4	0	0	100	DOWN SWITCH-OFF THRESHOLD

Table 9 – Test parameter and test steps 3 THRESHOLDS: Configuration Sequence

a	<address (a)>
1	BROADCAST
2	Short Address 5
3	GROUP 15

12.7.2.7 Test sequence 'ERROR HOLD-OFF TIME: Configuration Sequence'

In this sequence the ERROR HOLD-OFF TIME is tried to be changed with the configuration command 229 sent twice with a timeout of 150 ms as well as with command in-between the two configuration commands 229. The two commands 229 and the command in-between are to be sent within 100 ms. The test sequence is shown in Figure 15 and the test steps in Table 10.

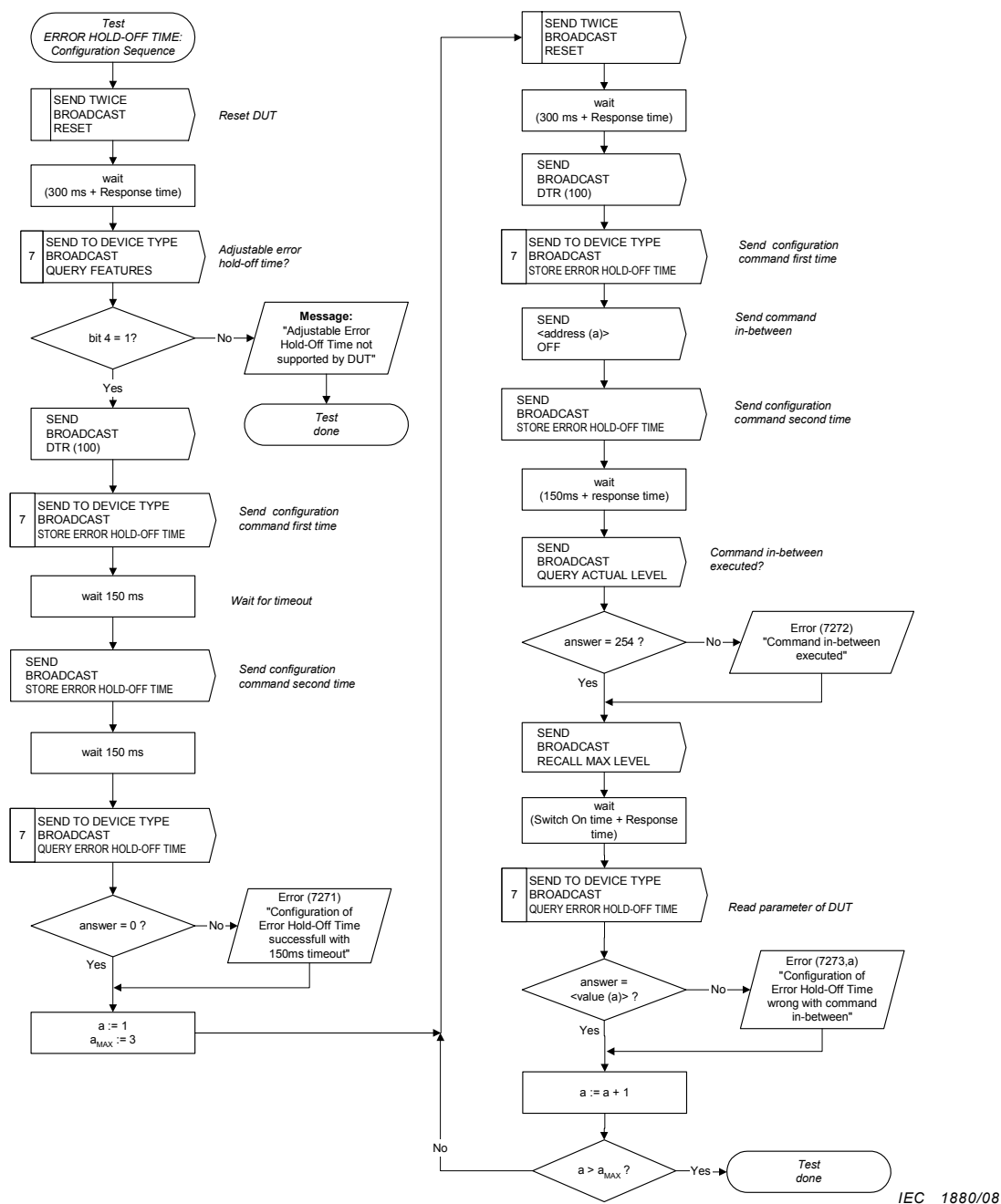


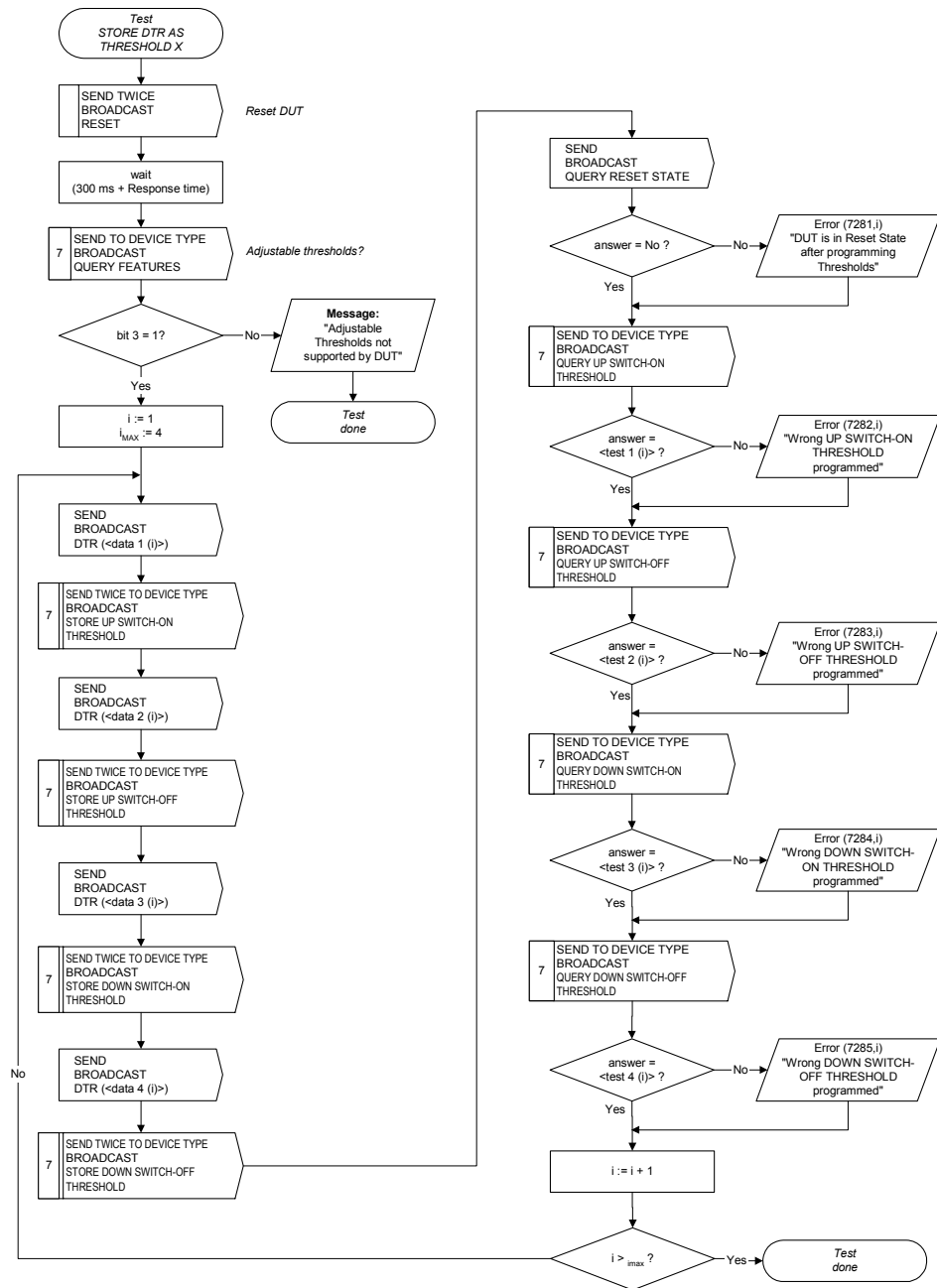
Figure 15 – Test sequence ERROR HOLD-OFF TIME: Configuration Sequence

Table 10 – Test steps ERROR HOLD-OFF TIME: Configuration Sequence

a	<address (a)>	<value (a)>
1	BROADCAST	0
2	Short Address 5	100
3	GROUP 15	100

12.7.2.8 Test sequence 'STORE DTR AS THRESHOLD X'

In this sequence programming of the four thresholds with respect to the range of validity is tested. The test sequence is shown in Figure 16 and the test steps in Table 11.



IEC 1881/08

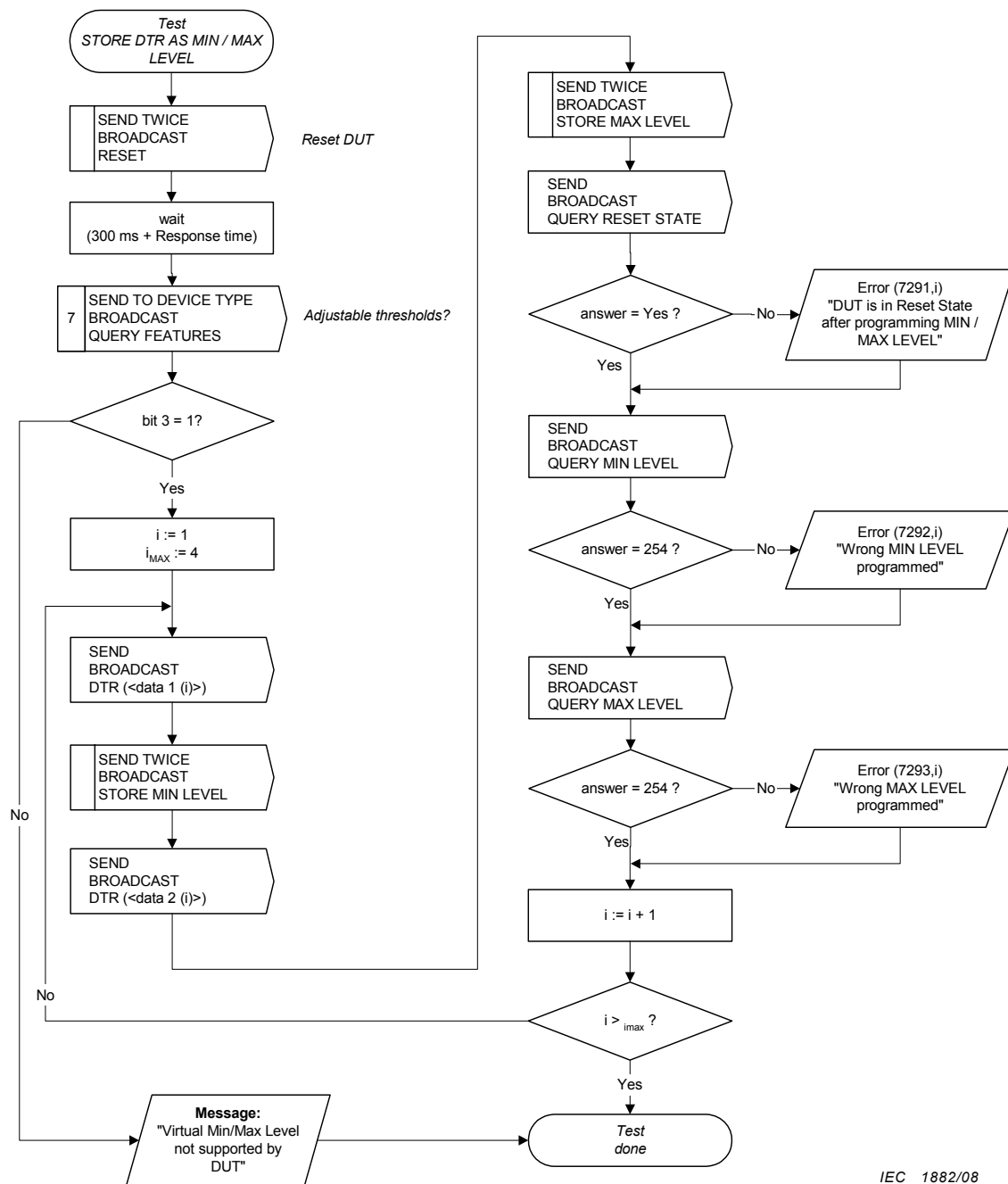
Figure 16 – Test sequence STORE DTR AS THRESHOLD X

Table 11 – Test steps STORE DTR AS THRESHOLD X

i	<data 1 (i)>	<data 2 (i)>	<data 3 (i)>	<data 4 (i)>	<test 1 (i)>	<test 2 (i)>	<test 3 (i)>	<test 4 (i)>
1	255	0	1	170	255	1	1	170
2	1	170	255	0	1	170	255	1
3	170	1	0	255	170	1	0	170
4	0	255	170	1	0	255	170	1

12.7.2.9 Test sequence 'STORE DTR AS MIN / MAX LEVEL'

In this sequence programming of the Min Level and the Max Level with respect to the range of validity is tested. The test sequence is shown in Figure 17 and the test steps in Table 12.



IEC 1882/08

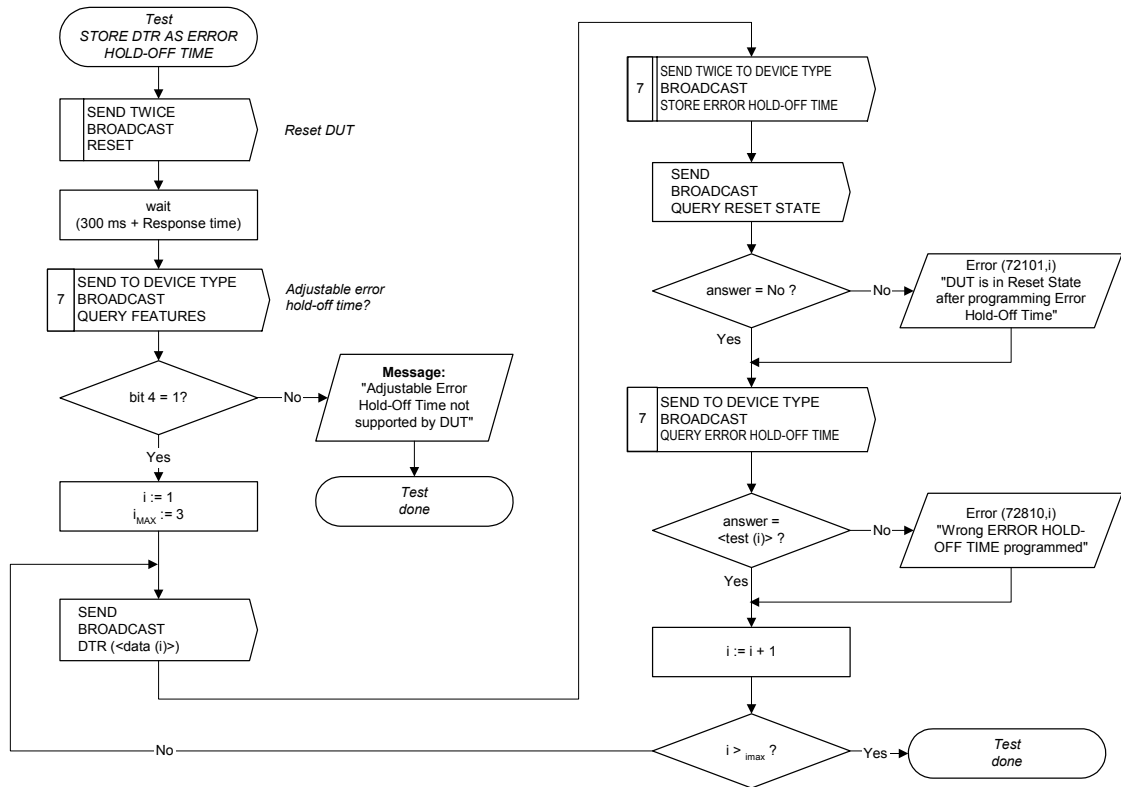
Figure 17 – Test sequence STORE DTR AS MIN / MAX LEVEL

Table 12 – Test steps STORE DTR AS MIN / MAX LEVEL

i	<data 1 (i)>	<data 2 (i)>	<test 1 (i)>	<test 2 (i)>
1	0	170	1	170
2	255	1	170	170
3	85	255	85	254
4	2	0	2	2

12.7.2.10 Test sequence 'STORE DTR AS ERROR HOLD-OFF TIME'

In this sequence programming of the Error Hold-Off Time with respect to the range of validity is tested. The test sequence is shown in Figure 18 and the test steps in Table 13.



IEC 1883/08

Figure 18 – Test sequence STORE DTR AS ERROR HOLD-OFF TIME

Table 13 – Test steps STORE DTR AS ERROR HOLD-OFF TIME

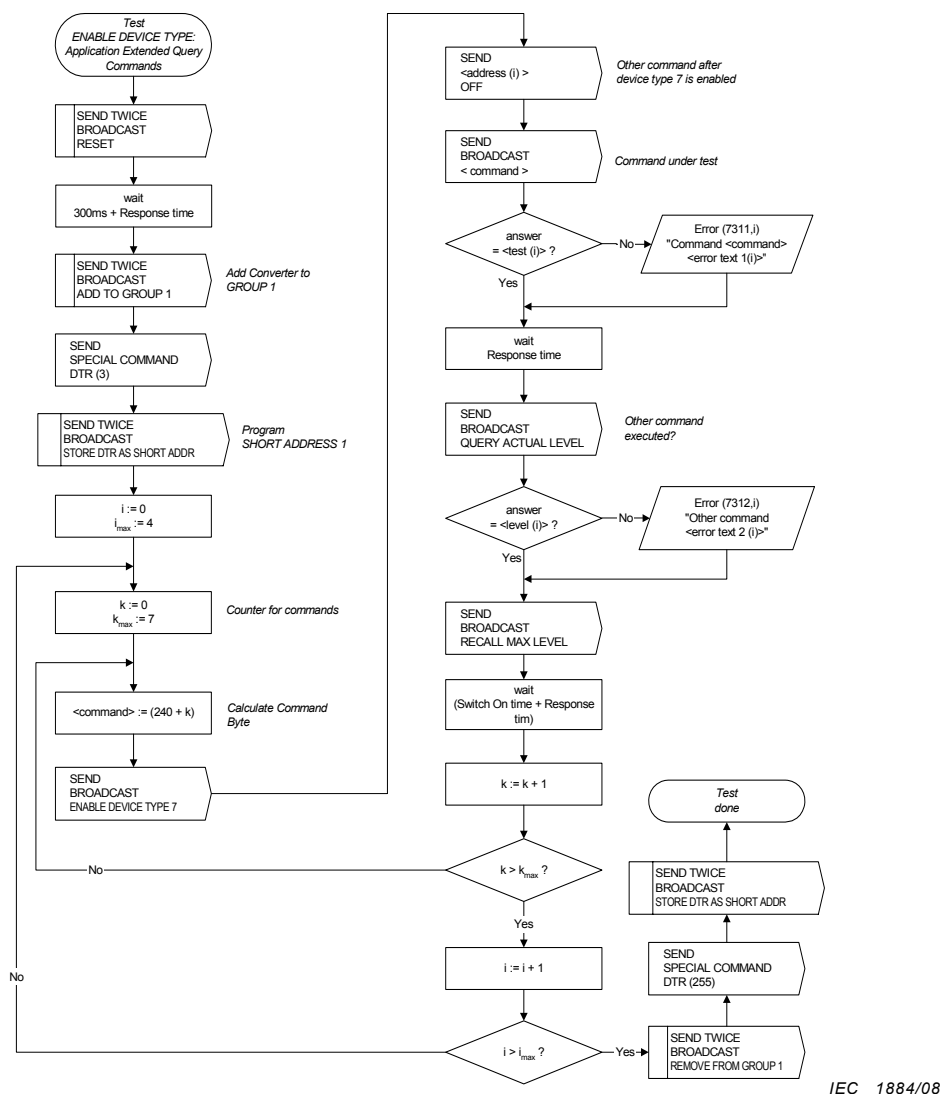
i	<data (i)>	<test (i)>
1	10	10
2	170	170
3	255	255

12.7.3 Test sequences 'ENABLE DEVICE TYPE'

The correct function of command 272 'ENABLE DEVICE TYPE' is tested with the following sequences.

12.7.3.1 Test sequence 'ENABLE DEVICE TYPE: Appl. extended query commands'

An application extended query command shall be executed if command 272 'ENABLE DEVICE TYPE 7' proceeds. If there is a command in-between command 272 and the application extended query command the application extended query command has to be ignored except the command in-between is addressed to another control gear. The test sequence is shown in Figure 19 and the test steps in Table 14.



IEC 1884/08

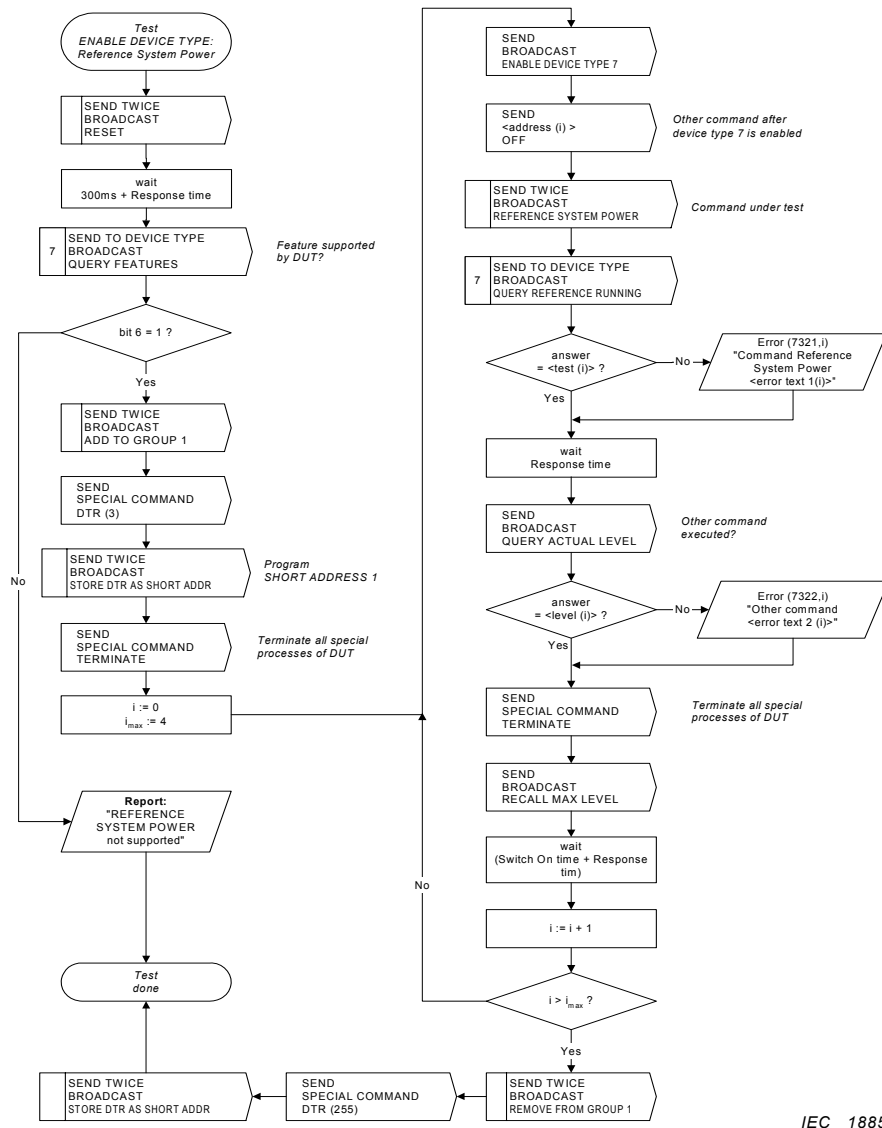
Figure 19 – Test sequence ENABLE DEVICE TYPE: Appl. extended query commands

Table 14 – Test steps ENABLE DEVICE TYPE: Appl. extended query commands

i	<address (i)>	<test (i)>	<level (i)>	<error text 1 (i)>	<error text 2 (i)>
0	BROADCAST	no answer	0	executed	not executed
1	Short Address 1	no answer	0	executed	not executed
2	Short Address 2	any reply	254	not executed	executed
3	GROUP 1	no answer	0	executed	not executed
4	GROUP 2	any reply	254	not executed	executed

12.7.3.2 Test sequence 'ENABLE DEVICE TYPE: Reference System Power'

An application extended configuration command shall be executed if command 272 'ENABLE DEVICE TYPE 7' precedes and the application extended configuration command is received twice within 100 ms. If there is a command in-between command 272 and the application extended configuration command addressed to the same control gear, the application extended configuration command has to be ignored. The test sequence uses command 224 'REFERENCE SYSTEM POWER' as application extended configuration command. The test sequence is shown in Figure 20 and the test steps in Table 15.



IEC 1885/08

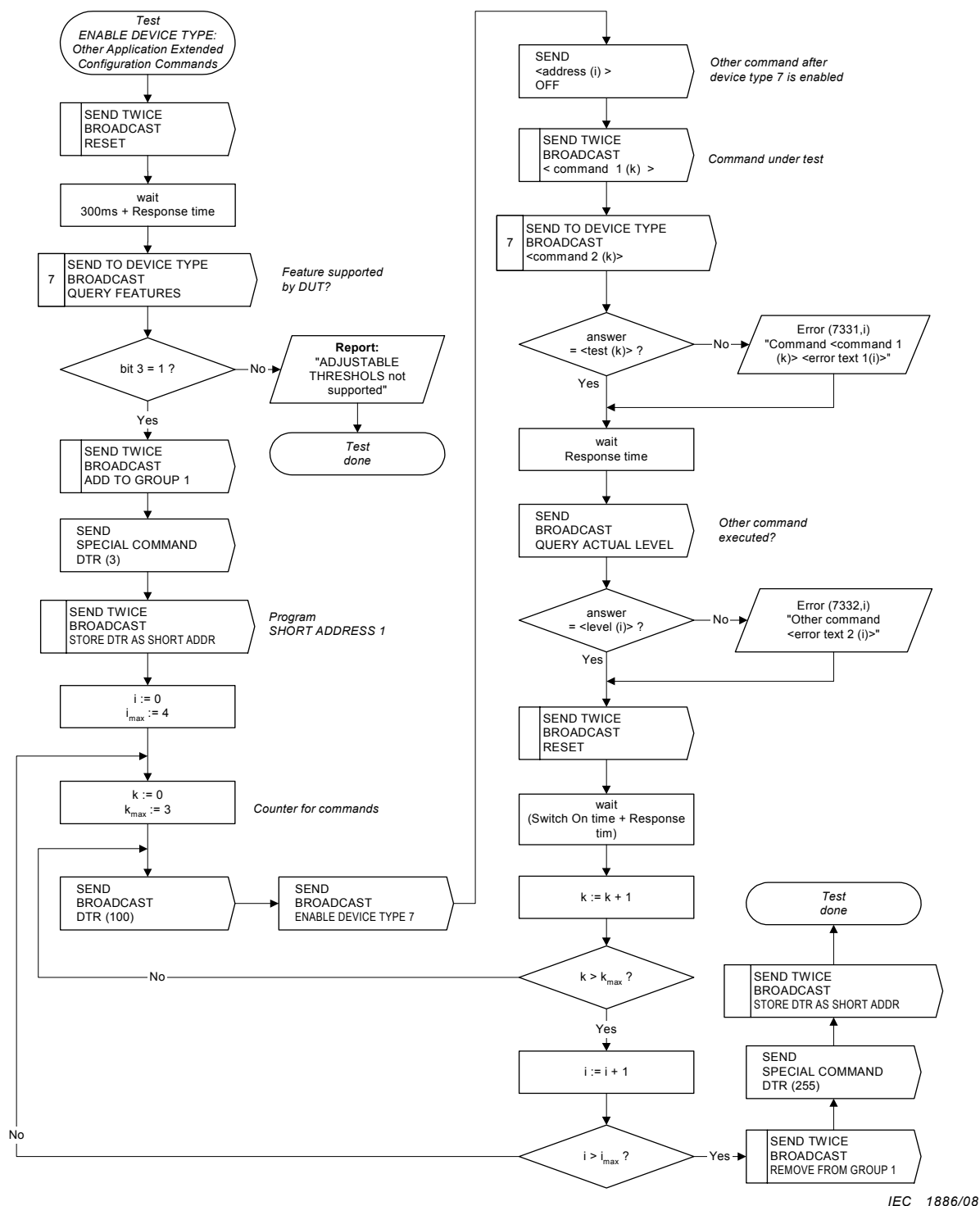
Figure 20 – Test sequence ENABLE DEVICE TYPE: Reference System Power

Table 15 – Test steps ENABLE DEVICE TYPE: Reference System Power

i	<address (i)>	<test (i)>	<level (i)>	<error text 1 (i)>	<error text 2 (i)>
0	BROADCAST	'No'	0	executed	not executed
1	Short Address 1	'No'	0	executed	not executed
2	Short Address 2	'Yes'	254	not executed	executed
3	GROUP 1	'No'	0	executed	not executed
4	GROUP 2	'Yes'	254	not executed	executed

12.7.3.3 Test sequence 'ENABLE DEVICE TYPE: Other Application Extended Configuration Commands'

An application extended configuration command shall be executed if command 272 'ENABLE DEVICE TYPE 7' precedes and the application extended configuration command is received twice within 100 ms. If there is a command in-between command 272 and the application extended configuration command addressed to the same control gear, the application extended configuration command has to be ignored. The test sequence uses the commands 225 – 228 as application extended configuration commands. The test sequence is shown in Figure 21 and the test steps in Tables 16, 17 and 18.



IEC 1886/08

Figure 21 – Test sequence ENABLE DEVICE TYPE: Other Application Extended Configuration Commands

Table 16 – Test steps 1 ENABLE DEVICE TYPE: Other Application Extended Configuration Commands

<i>k</i>	<command 1 (<i>k</i>)>	<command 2 (<i>k</i>)>
0	STORE DTR AS UP SWITCH-ON THRESHOLD	QUERY UP SWITCH-ON THRESHOLD
1	STORE DTR AS UP SWITCH-OFF THRESHOLD	QUERY UP SWITCH-OFF THRESHOLD
2	STORE DTR AS DOWN SWITCH-ON THRESHOLD	QUERY DOWN SWITCH-ON THRESHOLD
3	STORE DTR AS DOWN SWITCH-OFF THRESHOLD	QUERY DOWN SWITCH-OFF THRESHOLD

Table 17 – Test steps 2 ENABLE DEVICE TYPE: Other Application Extended Configuration Commands

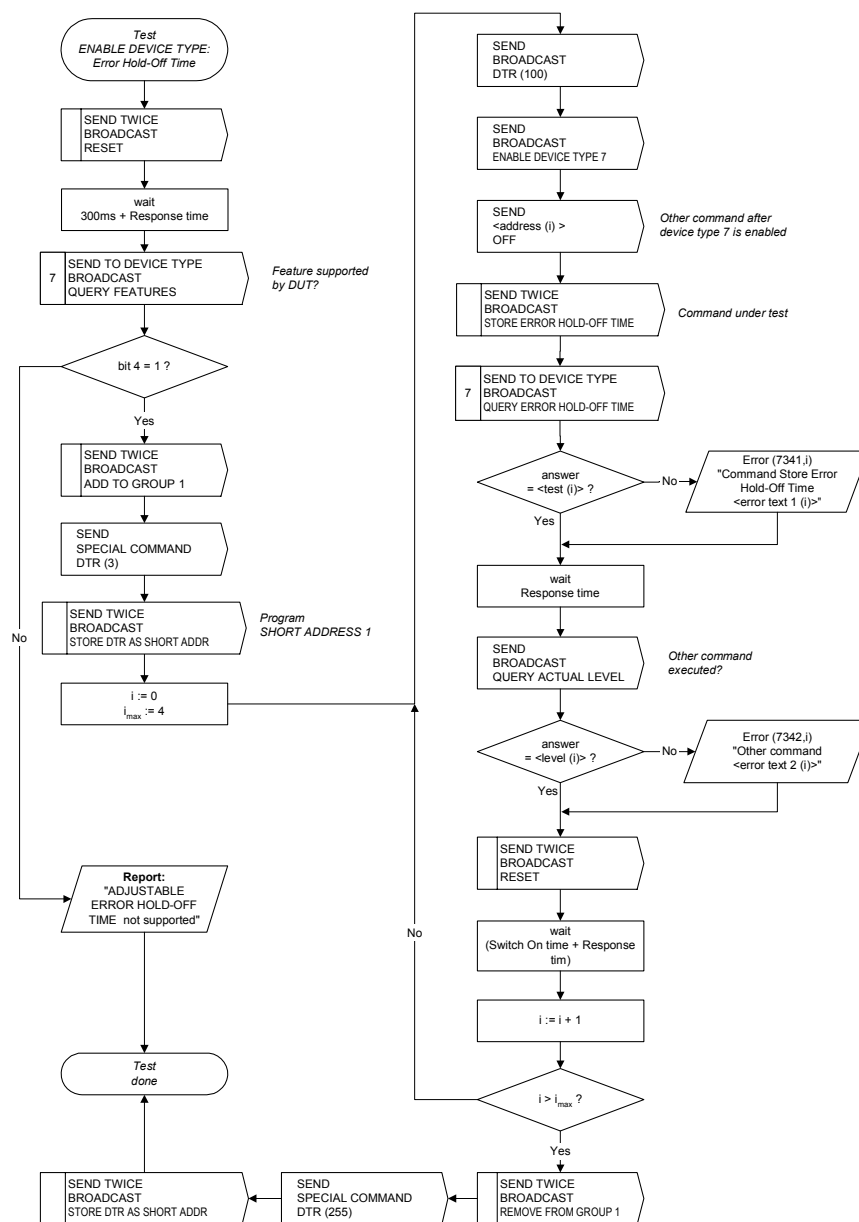
<i>k</i>	<test (<i>k</i>)>	
	<i>a</i> = 0, <i>a</i> = 1, <i>a</i> = 3	<i>a</i> = 2, <i>a</i> = 4
0	1	100
1	255	100
2	255	100
3	0	100

Table 18 – Test steps 3 ENABLE DEVICE TYPE: Other Application Extended Configuration Commands

<i>i</i>	<address (<i>i</i>)>	<level (<i>i</i>)>	<error text 1 (<i>i</i>)>	<error text 2 (<i>i</i>)>
0	BROADCAST	0	executed	not executed
1	Short Address 1	0	executed	not executed
2	Short Address 2	254	not executed	executed
3	GROUP 1	0	executed	not executed
4	GROUP 2	254	not executed	executed

12.7.3.4 Test sequence 'ENABLE DEVICE TYPE: Error Hold-Off Time'

An application extended configuration command shall be executed if command 272 'ENABLE DEVICE TYPE 7' precedes and the application extended configuration command is received twice within 100 ms. If there is a command in-between command 272 and the application extended configuration command addressed to the same control gear, the application extended configuration command has to be ignored. The test sequence uses command 229 'STORE DTR AS ERROR HOLD-OFF TIME' as application extended configuration command. The test sequence is shown in Figure 22 and the test steps in Table 19.



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Figure 22 – Test sequence ENABLE DEVICE TYPE: Error Hold-Off Time

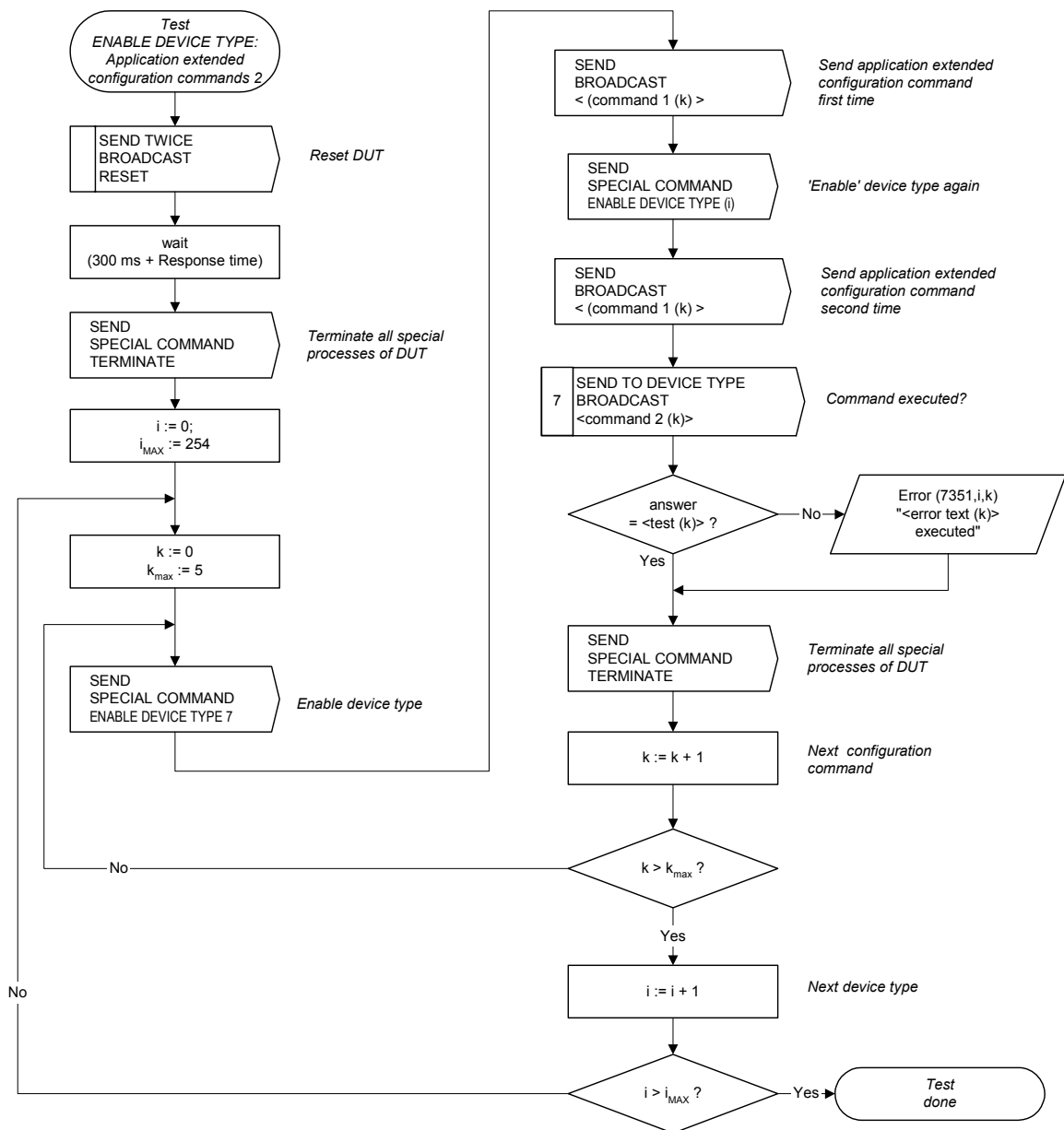
Table 19 – Test steps ENABLE DEVICE TYPE: Error Hold-Off Time

i	<address (i)>	<test (i)>	<level (i)>	<error text 1 (i)>	<error text 2 (i)>
0	BROADCAST	0	0	executed	not executed
1	Short Address 1	0	0	executed	not executed
2	Short Address 2	100	254	not executed	executed
3	GROUP 1	0	0	executed	not executed
4	GROUP 2	100	254	not executed	executed

12.7.3.5 Test sequence 'ENABLE DEVICE TYPE: Application Extended Configuration Commands 2'

An application extended configuration command shall be executed if command 272 'ENABLE DEVICE TYPE 7' precedes and the application extended configuration command is received twice within 100 ms. The application extended configuration command has to be ignored if a second command 272' ENABLE DEVICE TYPE' is received in-between the two application extended configuration commands. The two application extended configuration commands are

to be sent within 100 ms. The test sequence is shown in Figure 23 and the test steps in Tables 20 and 21.



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Figure 23 – Test sequence ENABLE DEVICE TYPE: Application Extended Configuration Commands 2