

RECOMMENDATION ITU-R BT.1304*

Checksum for error detection and status information in interfaces conforming with Recommendations ITU-R BT.656 and ITU-R BT.799

(Question ITU-R 42/6)

(1997)

The ITU Radiocommunication Assembly,

considering

- a) that many countries are installing digital television production facilities based on the use of digital video components conforming to Recommendations ITU-R BT.601 and ITU-R BT.656;
- b) that there exists the capacity within a signal conforming to Recommendation ITU-R BT.656 for additional data signals to be multiplexed with the video data signal itself;
- c) that there are operational and economic benefits to be achieved by the multiplexing of ancillary data signals with the video data signal;
- d) that the operational benefits are increased if a minimum of different formats are used for ancillary data signals;
- e) that some countries are already using ancillary data signals embedded in the video data signal,

recommends

1 that for optional error detection and provision of status information the methods described in Annex 1 for the generation of checkwords and status flags should be used in interfaces conforming with Recommendations ITU-R BT.656 and ITU-R BT.799.

Annex 1**Checksum for error detection and status information****1 Introduction**

This specification describes the generation of error detection checkwords and related status flags to be used optionally in conjunction with the serial digital interface described in Recommendation ITU-R BT.656.

* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2003 in accordance with Resolution ITU-R 44.

Two checkwords are defined: one based on a field of active picture video data words and the other on a full field of data words. This two-word approach provides continuing error detection for the active picture when the digital signal has passed through processing equipment that has changed the data outside the active picture area without recalculating the full-field checkword.

Three sets of flags are provided to feed forward information regarding detected errors to help facilitate identification of faulty equipment and the type of fault. One set of flags is associated with each of the two field related checkwords. A third set of flags is used to provide similar information based on evaluating all of the ancillary data checksums within a field. Implementation of these flags is optional.

The checkwords and flags are combined in an error detection data packet which is included as ancillary data. At the receiver, a recalculation of checkwords may be compared to the error detection data packet information to determine if a transmission error has occurred.

2 Location of checkwords, flags, identification number, and included samples

2.1 Location of checkwords, flags and identification number

Data packets containing the calculated checkwords, error information flags and identification number are located in the ancillary data area of the vertical interval as shown graphically in Figs. 1a and 1b and specified in Table 1 for 525/59.94 systems and Table 2 for 625/50 systems. These locations are chosen to respect the location of source switching points.

The error detection data packet is located immediately prior to the start of active video (SAV) code words in the line prior to that during which source switching occurs.

2.2 Samples included in checkword calculations

Starting and ending samples for active picture and full-field checkword calculations are shown in Table 3. For the active picture checkword, only the samples in the digital active picture area of each line are included in the calculation.

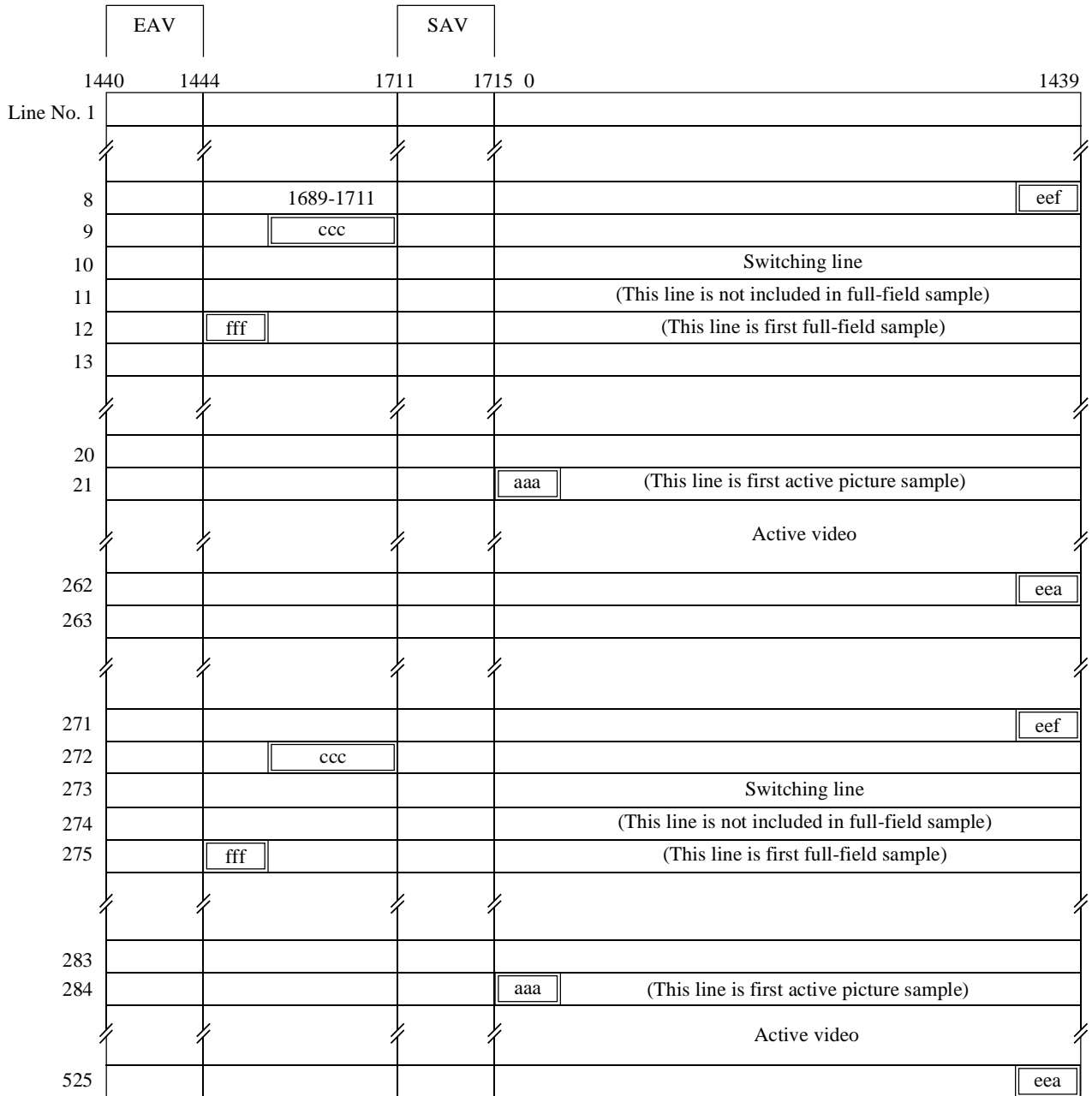
Full-field checkwords include all the samples in all lines except the line containing the error detection data packet and the two following lines.

TABLE 1
Location of 525/59.94 system checkwords

Error checking data locations: line 9, fields I and III and line 272, fields II and IV	
Data item	Word No.
Ancillary Data Flag word 1	1 689 (00.0 _h)
Ancillary Data Flag word 2	1 690 (FF.C _h)
Ancillary Data Flag word 3	1 691 (FF.C _h)
Data Identifier	1 692 (7D.0 _h)
Data Block Number	1 693 (80.0 _h)
Data Count	1 694 (44.0 _h)
Active picture data word 0	1 695
Active picture data word 1	1 696
Active picture data word 2	1 697
Full-field data word 0	1 698
Full-field data word 1	1 699
Full-field data word 2	1 700
Ancillary data error flags	1 701
Active picture error flags	1 702
Full-field error flags	1 703
Reserved words (7 total)	1 704-1 710
Checksum for this ancillary data packet	1 711

NOTE 1 – Values in parentheses are sample values.

FIGURE 1a
Location of checkwords and included samples (525-line systems)



EAV: end of active video.

- Note 1 – See Table 1 for exact sample locations in both fields.
- Note 2 – ccc: location of checkwords and status flags.
- Note 3 – fff: first sample included in the full-field checkword.
- Note 4 – aaa: first sample included in the active picture checkword.
- Note 5 – eea: last sample included in the active picture checkword.
- Note 6 – eef: last sample included in the full-field checkword.

FIGURE 1b
Location of checkwords and included samples (625-line systems)

	EAV		SAV	
	1440	1444	1723	1727 0
Line No. 624				
625				
1				
	//	//	//	//
4				eef
5		ccc		
6				Switching line
7				(This line is not included in full-field sample)
8		fff		(This line is first full-field sample)
9				
10				
11				
	//	//	//	//
22				
23				
24			aaa	(This line is first active picture sample)
	//	//	//	//
				Active video
310				eea
311				
	//	//	//	//
317				eef
318		ccc		
319				Switching line
320				(This line is not included in full-field sample)
321		fff		(This line is first full-field sample)
	//	//	//	//
335				
336			aaa	(This line is first active picture sample)
	//	//	//	//
				Active video
622				eea

Note 1 – See Table 2 for exact sample locations in both fields.

Note 2 – ccc: location of checkwords and status flags.

Note 3 – fff: first sample included in the full-field checkword.

Note 4 – aaa: first sample included in the active picture checkword.

Note 5 – eea: last sample included in the active picture checkword.

Note 6 – eef: last sample included in the full-field checkword.

TABLE 2

Location of 625/50 system checkwords

Error checking data locations: line 5, field I and line 318, fields II	
Data item	Word No.
Ancillary Data Flag word 1	Y 850 (00.0 _h)
Ancillary Data Flag word 2	C _r 425 (FF.C _h)
Ancillary Data Flag word 3	Y 851 (FF.C _h)
Data Identifier	C _b 426 (7D.0 _h)
Data Block Number	Y 852 (80.0 _h)
Data Count	C _r 427 (44.0 _h)
Active picture data word 0	Y 853
Active picture data word 1	C _b 428
Active picture data word 2	Y 854
Full-field data word 0	C _r 429
Full-field data word 1	Y 855
Full-field data word 2	C _b 430
Ancillary data error flags	Y 856
Active picture error flags	C _r 431
Full-field error flags	Y 857
Reserved words (7 total)	C _b 432
Checksum for this ancillary data packet	Y 858

NOTE 1 – Values in parentheses are sample values.

TABLE 3

Checkword included samples

Data item	13.5 MHz component
525/59.94 systems	
First full-field sample, lines 12 and 275	1 444
First active picture sample, lines 21 and 284	0
Last active picture sample, lines 262 and 525	1 439
Last full-field sample, lines 8 and 271	1 439
625/50 systems	
First full-field sample, lines 8 and 321	C _b 361
First active picture sample, lines 24 and 336	C _b 0
Last active picture sample, lines 310 and 622	Y 719
Last full-field sample, lines 4 and 317	Y 719

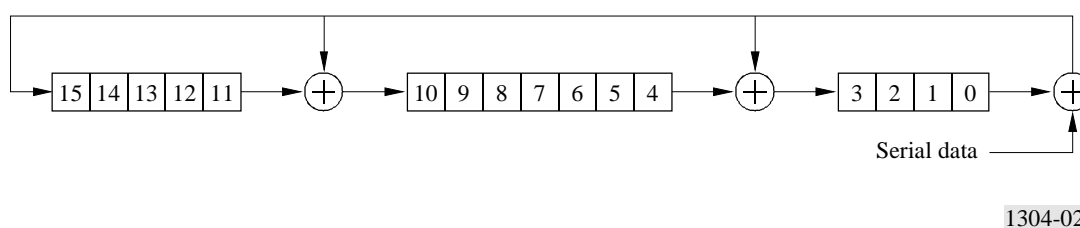
3 Definitions of data words

3.1 Checkword values

Each checkword value consists of 16 bits of data calculated using the Cyclic Redundancy Check (CRC) polynomial generation method. The equation and a conceptual logic diagram (see Fig. 2) are shown below:

$$\text{Checkword (16 bit)} = x^{16} + x^{12} + x^5 + 1$$

FIGURE 2



All data words with values between FF.0_h and FF.8_h inclusive are recoded to FF.C_h at the input to the CRC polynomial generator. This recoding is necessary only at the polynomial generator, for the purposes of ensuring compatibility between 8-bit and 10-bit equipment and between different implementations of serial digital interface time reference signals and ancillary data flag coding.

3.2 Ancillary data housekeeping, checkwords and flags

Definitions of each ancillary data word specified are shown in Table 4. Zeros are used in the two least significant bits (LSBs) of all words in the data packet to provide compatibility with 8-bit equipment. Bit b₇ (V) in picture/field data word 3 is a 1 if a valid CRC has been calculated. A P in b₈ provides even parity for b₇ through b₀; that is, the total number of 1s in b₈-b₀ is an even number. The most significant bit (MSB), b₉, is the logical inverse of b₈. A checksum is the last word in the error detection data packet.

The checksum word is used to determine the validity of the included words. The checksum word consists of 9 bits and is the sum of the 9 LSBs (b₈-b₀) of all words including the Data Identifier (DID) and the Reserved Words. The sum is preset to all zeros at the start of each calculation and the carry ignored.

TABLE 4

Definition of ancillary data words

Data item	b ₉ MSB	b ₈	b ₇	b ₆	b ₅	b ₄	b ₃	b ₂	b ₁	b ₀ LSB
Ancillary data header, ancillary data flag (ADF), word 1	0	0	0	0	0	0	0	0	0	0
Ancillary data header, ADF, word 2	1	1	1	1	1	1	1	1	1	1
Ancillary data header, ADF, word 3	1	1	1	1	1	1	1	1	1	1
Data identifier (7D.0 _h)	0	1	1	1	1	1	0	1	0	0
Data block number (80.0 _h)	1	0	0	0	0	0	0	0	0	0
Data count (44.0 _h)	0	1	0	0	0	1	0	0	0	0
Active picture data count word 0 CRC<5:0>	P/	P	c	c	c	c	c	c	0	0
Active picture data count word 1 CRC<11:6>	P/	P	c	c	c	c	c	c	0	0
Active picture data count word 0 CRC<15:12>	P/	P	V	0	c	c	c	c	0	0
Full-field data word 0 CRC<5:0>	P/	P	c	c	c	c	c	c	0	0
Full-field data word 0 CRC<11:6>	P/	P	c	c	c	c	c	c	0	0
Full-field data word 0 CRC<15:12>	P/	P	V	0	c	c	c	c	0	0
Ancillary data error flags	P/	P	0	ues	ida	idh	eda	edh	0	0
Active picture error flags	P/	P	0	ues	ida	idh	eda	edh	0	0
Full-field error flags	P/	P	0	ues	ida	idh	eda	edh	0	0
Reserved words (7 total)	1/	0	0	0	0	0	0	0	0	0
Checksum	S8/	S8	S7	S6	S5	S4	S3	S2	S1	S0

NOTE 1 – P and V are defined in § 3.2.

3.3 Error flags

3.3.1 Definition of individual error status flags

All error flags indicate only the status of the previous field; that is, each flag is set or cleared on a field-by-field basis. A logical 1 is the set state and a logical 0 is the unset state. The flags are defined as follows:

edh – error detected here: signifies that a serial transmission error was detected. In the case of ancillary data, this means that one or more ancillary data blocks did not match its checksum.

eda – error detected already: signifies that a serial transmission error has been detected at a prior point in the signal path. If a device receives a signal in which the edh flag has been set, then that device will forward the data with the eda flag set and the edh flag set to zero if there is no further error in the data.

idh – internal error detected here: signifies that a hardware error unrelated to serial transmission has been detected within a device. This is provided specifically for devices which have internal error-checking facilities, as an error reporting mechanism.

ida – internal error detected already: signifies that an idh flag was received and there was a hardware device failure at a prior point in the signal chain.

ues – unknown error status: signifies that a serial signal was received from a device not supporting this error-detection practice.

3.3.2 Degrees of implementation

Individual error status flags, or all such flags, may not be supported by all equipment. To maintain compatibility with full implementations of this specification, in all such cases where one or more error status flags are not supported, the unsupported flags are set to zero.
