

Tables Referred to in Chapter 30

- 30.1 ITA2 (Baudot) and AMTOR Codes
- 30.2 Baudot Signaling Rates and Speeds
- 30.3 The ASCII Coded Character Set
- 30.4 Conversion from ASCII to Morse and Baudot
- 30.5 Code Conversion, ITA1 through 4 (Notes 1 and 2)
- 30.6 Data Interface Connections
- 30.7 EIA-449 37-Pin Connector Assignments
- 30.8 EIA-449 9-Pin Connector Assignments
- 30.9 RTTY Control Sequences (from CCITT Recommendation S.4)
- 30.10 ISO 3593 Pin Allocations for V.35 Interfaces

Copyright © 1999 by The American Radio Relay League, Inc.

Copyright secured under the Pan-American Convention

International Copyright secured

This work is Publication no. 6 of the Radio Amateur's Library, published by the League. All rights reserved. No part of this work may be reproduced in any form except by written permission of the publisher. All rights of translation are reserved.

Printed in the USA

Quedan reservados todos los derechos

77th Edition

ISBN: 0-87259-183-2

Bit Number				Hex 2nd	1st	0	1	2	3	4	5	6	7		
3	2	1	0												
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p		ACK	acknowledge
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q		BEL	bell
0	0	1	0	2	STX	DC2	"	2	B	R	b	r		BS	backspace
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s		CAN	cancel
0	1	0	0	4	EOT	DC4	\$	4	D	T	d	t		CR	carriage return
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u		DC1	device control 1
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v		DC2	device control 2
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w		DC3	device control 3
1	0	0	0	8	BS	CAN	(	8	H	X	h	x		DC4	device control 4
1	0	0	1	9	HT	EM	)	9	I	Y	i	y		DEL	(delete)
1	0	1	0	A	LF	SUB	*	:	J	Z	j	z		DLE	data link escape
1	0	1	1	B	VT	ESC	+	;	K	[	k	{		ENQ	enquiry
1	1	0	0	C	FF	FS	,	<	L	\	l	|		EM	end of medium
1	1	0	1	D	CR	GS	-	=	M	]	m	}		EOT	end of transmission
1	1	1	0	E	SO	RS	.	>	N	^	n	~		ESC	escape
1	1	1	1	F	SI	US	/	?	O	_	o	DEL		ETB	end of block
														ETX	end of text
														FF	form feed
														FS	file separator
														GS	group separator
														HT	horizontal tab
														LF	line feed
														NAK	negative acknowledge
														NUL	null
														RS	record separator
														SI	shift in
														SO	shift out
														SOH	start of heading
														SP	space
														STX	start of text
														SUB	substitute
														SYN	synchronous idle
														US	unit separator
														VT	vertical tab

Notes

1. "1" = mark, "0" = space.
2. Bit 6 is the most-significant bit (MSB). Bit 0 is the least-significant bit (LSB).

30.2 ITA2 (Baudot) and AMTOR Codes

Combination No.	ITA2 ¹ Code		CCIR 476 ² Code		Character Set		
	Bit No. 43210	Hex	Bit No. 6543210	Hex	Letters Case	ITA2	Figures Case U.S. TTys ³
1	00011	03	1000111	47	A	—	—
2	11001	19	1110010	72	B	?	?
3	01110	0E	0011101	1D	C	:	:
4	01001	09	1010011	53	D	5	\$
5	00001	01	1010110	56	E	3	3
6	01101	0D	0011011	1 B	F	4	!
7	11010	1A	0110101	35	G	4	&
8	10100	14	1101001	69	H	4	# or motor stop
9	00110	06	1001101	4D	I	8	8
10	01011	0B	0010111	17	J	BELL	'
11	01111	0F	0011110	1E	K	((
12	10010	12	1100101	65	L))
13	11100	1C	0111001	39	M	.	.
14	01100	0C	1011001	59	N	,	,
15	11000	18	1110001	71	O	9	9
16	10110	16	0101101	2D	P	0	0
17	10111	17	0101110	2E	Q	1	1
18	01010	0A	1010101	55	R	4	4
19	00101	05	1001011	4B	S	'	BELL
20	10000	10	1110100	74	T	5	5
21	00111	07	1001110	4E	U	7	7
22	11110	1E	0111100	3C	V	=	;
23	10011	13	0100111	27	W	2	2
24	11101	1D	0110101	3A	X	/	/
25	10101	15	0101011	2B	Y	6	6
26	10001	11	1100011	63	Z	+	"
27	01000	08	1111000	78	← CR (Carriage return)		
28	00010	02	1101100	6C	= LF (Line feed)		
29	11111	1F	1011010	5A	↓ LTRS (Letter shift)		
30	11011	1B	0110110	36	↑ FIGS (Figure shift)		
31	00100	04	1011100	5C	SP (Space)		
32	00000	00	1101010	6A	BLK (Blank)		

Notes

¹1 represents the mark condition (shown as Z in ITU recommendations) which is the higher emitted radio frequency for FSK, the lower audio frequency for AFSK. 0 represents the space condition (shown as A in ITU documents). Bits are numbered 0 (least-significant bit) through 4 (most-significant bit). The order of bit transmission is LSB first, MSB last. Symbols A and Z are defined in CCIR Rec. R.140.

²1 represents the mark condition (shown as B in CCIR recommendations), which is the higher emitted radio frequency for FSK, the lower audio frequency for AFSK. 0 represents the space condition (shown as Y in CCIR recommendations). Bits are numbered 0 (LSB) through 6 (MSB). The order of bit transmission is LSB first, MSB last.

³Many U.S. teletypewriters have these figures case characters.

⁴At present unassigned. Reception of these signals, however, should not initiate a request for repetition.

⁵The pictorial representations of ☒ or ☒ indicate WRU (Who are you?), which is used for an answer-back function in telex networks.

30.3 Baudot Signaling Rates and Speeds

Signaling Rate (bauds)	Data Pulse (ms)	Stop Pulse (ms)	Speed (WPM)	Common Name
45.45	22.0	22.0	65.00	Western Union
	22.0	31.0	61.33	"60 speed"
	22.0	33.0	60.61	45 bauds
50.00	20.0	30.0	66.67	European; 50 bauds
56.92	17.57	25.00	76.68	"75 speed"
	17.57	26.36	75.89	57 bauds
74.20	13.47	19.18	100.00	"100 speed"
	13.47	20.21	98.98	74 bauds
100.0	10.00	15.00	133.33	100 bauds

ASCII		Int'l Morse		Baudot		ASCII		Int'l Morse		Baudot	
Code	Char	Code	Char	Code	Char ²	Code	Char	Code	Char	Code	Char ²
0000000	NUL			↑↓ 00000	Blank	1000001	A	• -	A	↓ 00011	A
0000001	SOH					1000010	B	- •••	B	↓ 11001	B
0000010	STX					1000011	C	- • - •	C	↓ 01110	C
0000011	ETX					1000100	D	- ••	D	↓ 01001	D
0000100	EOT					1000101	E	•	E	↓ 00001	E
0000101	ENQ			↑ 01001	WRU (ITA)	1000110	F	•• - •	F	↓ 01101	F
0000110	ACK			↑ 01011	Bell (ITA)	1000111	G	- - •	G	↓ 11010	G
0000111	BEL			↑ 00101	Bell (U.S.)	1001000	H	••••	H	↓ 10100	H
						1001001	I	••	I	↓ 00110	I
0001000	BS					1001010	J	• - - -	J	↓ 01011	J
0001001	HT					1001011	K	- • -	K	↓ 01111	K
0001010	LF			↑↓ 00010	LF	1001100	L	• - ••	L	↓ 10010	L
0001011	VT					1001101	M	- -	M	↓ 11100	M
0001100	FF					1001110	N	- •	N	↓ 01100	N
0001101	CR			↑↓ 01000	CR	1001111	O	- - -	O	↓ 11000	O
0001110	SO					1010000	P	• - - •	P	↓ 10110	P
0001111	SI					1010001	Q	- - • -	Q	↓ 10111	Q
0010000	DLE					1010010	R	• - •	R	↓ 01010	R
0010001	DC1					1010011	S	•••	S	↓ 00101	S
0010010	DC2					1010100	T	-	T	↓ 10000	T
0010011	DC3					1010101	U	•• -	U	↓ 00111	U
0010100	DC4					1010110	V	••• -	V	↓ 11110	V
0010101	NAK					1010111	W	• - - -	W	↓ 10011	W
0010110	SYN					1011000	X	- •• -	X	↓ 11101	X
0010111	ETB					1011001	Y	- • - -	Y	↓ 10101	Y
0011000	CAN					1011010	Z	- - ••	Z	↓ 10001	Z
0011001	EM					1011011	[
0011010	SUB					1011100	\				
0011011	ESC					1011101]				
0011100	FS					1011110	^				
0011101	GS					1011111	^				
0011110	RS					1011111	^				
0011111	US					1011111	^				
0100000	SP	Space		00100	SP	1100000	˘	•• - - - •	IQ_		
0100001	!					1100001	a	• -	A	↓ 00011	A
0100010	"	• - •• - •	AF "	↑ 10001	" (U.S.)	1100010	b	- •••	B	↓ 11001	B
0100011	#			↑ 10100	# (U.S.)	1100011	c	- • - •	C	↓ 01110	C
0100100	\$	••• - •• -	SX \$	↑ 01001	\$ (U.S.)	1100100	d	- ••	D	↓ 01001	D
0100101	%					1100101	e	•	E	↓ 00001	E
0100110	&					1100110	f	•• - •	F	↓ 01101	F
0100111	'	• - - - - •	WG '	↑ 00101	' (ITA)	1100111	g	- - •	G	↓ 11010	G
				↑ 01011	' (U.S.)	1101000	h	••••	H	↓ 10100	H
0101000	(	- • - - •	KN (	↑ 01111	(	1101001	i	••	I	↓ 00110	I
0101001	)	- • - - - •	KK)	↑ 10010	)	1101010	j	• - - -	J	↓ 01011	J
0101010	*					1101011	k	- • -	K	↓ 01111	K
0101011	+	•• - ••	AR +	↑ 10001	+ (ITA)	1101100	l	••••	L	↓ 10010	L
0101100	,	- •• -	MIM ,	↑ 01100	,	1101101	m	- -	M	↓ 11100	M
0101101	-	- •••• -	DU -	↑ 00011	-	1101110	n	- •	N	↓ 01100	N
0101110	.	•• - •• -	AAA .	↑ 11100	.	1101111	o	- - -	O	↓ 11000	O
0101111	/	- ••••	DN /	↑ 11101	/	1110000	p	•• - •	P	↓ 10110	P
0110000	0	- - - - -	0	↑ 10110	0	1110001	q	- - • -	Q	↓ 10111	Q
0110001	1	• - - - -	1	↑ 10111	1	1110010	r	•••	R	↓ 01010	R
0110010	2	•• - - -	2	↑ 10011	2	1110011	s	•••	S	↓ 00101	S
0110011	3	••• - -	3	↑ 00001	3	1110100	t	-	T	↓ 10000	T
0110100	4	•••• -	4	↑ 01010	4	1110101	u	•• -	U	↓ 00111	U
0110101	5	•••••	5	↑ 10000	5	1110110	v	••• -	V	↓ 11110	V
0110110	6	- ••••	6	↑ 10101	6	1110111	w	• - -	W	↓ 10011	W
0110111	7	- - •••	7	↑ 00111	7	1111000	x	- •• -	X	↓ 11101	X
0111000	8	- - - ••	8	↑ 00110	8	1111001	y	- • - -	Y	↓ 10101	Y
0111001	9	- - - - •	9	↑ 11000	9	1111010	z	- - ••	Z	↓ 10001	Z
0111010	:	- - - - ••	OS :	↑ 01110	:	1111011	{				
0111011	;	- •• - ••	KR ;	↑ 11110	;	1111100	|				
0111100	<					1111101	}				
0111101	=	- •• -	BT =	↑ 11110	= (ITA)	1111110	~				
0111110	>					1111111	DEL				
0111111	?	•• - - ••	IMI ?	↑ 11001	?						
1000000	@										

Notes

¹ In Baudot code, it is necessary to check to see what the current case is before conversion (↓ = letters, ↑ = figures, ↓↑ = either case).

² Figures—case characters are the same for both ITA2 and U.S. teletype

Combination number	ITA1 Bit No. 43210	Figure Case ITA1	Letter Case All Codes	Figure Case ITA2-4	ITA2 Bit No. 43210	ITA3 Bit No. 6543210	ITA4 Bit No. 543210
1	++++-	1	A	—	00011	0101100	000110
2	+----+	8	B	?	11001	1001100	110010
3	+---+-	9	C	:	01110	0011001	011100
4	+-----	0	D	Note 4	01001	0011100	010010
5	+++++	2	E	3	00001	0001110	000010
6	+----+	Note 3	F	Note 4	01101	1100100	011010
7	+---+-	7	G	Note 4	11010	1000011	110100
8	+--+--	+	H	Note 4	10100	0100101	101000
9	+++++	Note 3	I	8	00110	0000111	001100
10	+----+	6	J	BELL	01011	1100010	011010
11	---+--	(	K	(	01111	1101000	011110
12	---+--	=	L	)	10010	0100011	100100
13	---+--	)	M	.	11100	1000101	111000
14	----++	Note 3	N	,	01100	0010101	011000
15	++-----	5	O	9	11000	0110001	110000
16	-----	%	P	0	10110	0101001	101100
17	---+--	/	Q	1	10111	1011000	101110
18	----++	—	R	4	01010	0010011	010100
19	+----+	.	S	'	00101	0101010	001010
20	--+--	Note 3	T	5	10000	1010001	100000
21	++-+-	4	U	7	00111	0100110	001110
22	+----+	'	V	=	11110	1001001	111100
23	---+--	?	W	2	10011	1010010	100110
24	--+--	,	X	/	11101	0110100	111010
25	++-+++	3	Y	6	10101	1010100	101010
26	--+--	:	Z	+	10001	1000110	100010
27	+++--	Carriage return		Carriage return	01000	1100001	010000
28	---+--	Line feed		Line feed	00010	0001101	000100
29	----++	Letter blank (space)		Letter shift	11111	0111000	111110
30	+----+	Figure blank (space)		Figure shift	11011	0110010	110110
31	---+--	Error		Space	00100	0001011	001000
32	+++++	Instrument at rest		Blank	00000	1110000	000001
—				Phasing signal	—	—	110011
—				Signal repetition	—	0010110	—
—				Signal alpha	Note 5	1001010	000000
—				Signal beta	Note 6	0011010	111111

30.6

Data Interface Connections

<i>Pin</i>	<i>Ckt</i>	<i>EIA-232-D Description</i>	<i>V. 24 No.</i>	<i>Name</i>	<i>Common Abbr.*</i>
1	—	Shield			
2	BA	Transmitted Data	103	Transmitted Data	TxD
3	BB	Received Data	104	Received Data	RxD
4	CA	Request to Send	105	Request to Send	RTS
5	CB	Clear to Send	106	Clear to Send	CTS
6	CC	DCE Ready	107	Data Set Ready	DSR
7	AB	Signal Ground	102	Signal Ground	SG
8	CF	Received Line Signal Detector	109	Data Carrier Detect	CD
9	—	(Reserved for Testing)			
10	—	(Reserved for Testing)			
11	—	Unassigned			
12	SCF/CI	Sec. Rec'd Line Sig. Detector/Data Sig. Rate Select (DCE Source)	122	Backward Channel Received Line Signal Detector	SCD
13	SCB	Sec. Clear to Send	121	Backward Channel Ready	SCTS
14	SBA	Sec. Transmitted Data	118	Transmitted Backward Channel Data	STxD
15	DB	Transmission Signal Element Timing (DCE Source)	114	Transmitter Signal Element Timing (DCE Source)	TxC
16	SSB	Sec. Received Data	119	Received Backward Channel Data	SRxD
17	DD	Receiver Signal Element Timing (DCE Source)	115	Receiver Signal Element	RxC
18	LL	Local Loopback			
19	SCA	Sec. Request to Send	120	Transmitted Backward Line Signal	SRTS
20	CD	DTE Ready	108/2	Data Terminal Ready	DTR
21	RL/CG	Remote Loopback/Signal Quality Detector	110	Data Signal Quality Detector	SQ
22	CE	Ring Indicator	125	Calling Indicator	RI
23	CH/CI	Data Signal Rate Select (DTE/DCE Source)	111	Data Rate Selector	
			112	Data Rate Selector	
24	DA	Transmit Signal Element Timing (DTE Source)	113	Transmitter Signal Element Timing, (DTE Source)	ETxC
25	TM	Test Mode			

*Most abbreviations in this column are generally recognized by association with their full names. Exceptions are: ETxC=External Transmitter Clock, RxC=Receiver Clock and TxC=Transmitter Clock.

30.7

EIA-449 37-Pin Connector Assignments

<i>Pin</i>	<i>Direction</i>	<i>Mnemonic</i>	<i>Circuit name</i>	<i>Pin</i>	<i>Direction</i>	<i>Mnemonic</i>	<i>Circuit name</i>
1	—	SHIELD		19	—	SG	Signal ground
2	from DCE	SI	Signaling rate indicator	20	from DCE	RC	Receive common
3	—	SPARE		21	—	SPARE	
4	to DCE	SD	Send data	22	to DCE	SD	Send data
5	from DCE	ST	Send timing	23	from DCE	ST	Send timing
6	from DCE	RD	Receive data	24	from DCE	RD	Receive data
7	to DCE	RS	Request to send	25	to DCE	RS	Request to send
8	from DCE	RT	Receive timing	26	from DCE	RT	Receive timing
9	from DCE	CS	Clear to send	27	from DCE	CS	Clear to send
10	to DCE	LL	Local loopback	28	to DCE	IS	Terminal in service
11	from DCE	DM	Data mode	29	from DCE	DM	Data mode
12	to DCE	TR	Terminal ready	30	to DCE	TR	Terminal ready
13	from DCE	RR	Receiver ready	31	from DCE	RR	Receiver ready
14	to DCE	RL	Remote loopback	32	to DCE	SS	Select standby
15	from DCE	IC	Incoming call	33	from DCE	SQ	Signal quality
16	to DCE	SF/SR	Select frequency	34	to DCE	NS	New signal
			Signaling rate selector	35	to DCE	TT	Terminal timing
17	to DCE	TT	Terminal timing	36	from DCE	SB	Standby indicator
18	from DCE	TM	Test mode	37	to DCE	SC	Send common

30.8 EIA-449 9-Pin Connector Assignments

Pin	Direction	Mnemonic	Circuit Name
1	—	SHIELD	
2	from DCE	SRR	Secondary receiver ready
3	to DCE	SSD	Secondary send data
4	from DCE	SRF	Secondary receive data
5	—	SG	Signal ground
6	—	RC	Receive common
7	to DCE	SRS	Secondary request to send
8	from DCE	SCS	Secondary clear to send
9	to DCE	SC	Send common

30.9 ISO 2593 Pin Allocations for V.35 Interfaces

Pin	Circuit	Direction	Function	Pin	Circuit	Direction	Function
A	101	Common	Protective ground or earth	AA	114	to DTE	Transmitter signal element timing B-wire
B	102	Common	Signal ground or common return	P	103	from DTE	Transmitted data A-wire
C	105	from DTE	Request to send	S	103	from DTE	Transmitted data B-wire
D	106	to DTE	Ready for sending	U	113	from DTE	Transmitter signal element timing A-wire
E	107	to DTE	Data set ready	Z	—	—	F ₃
F	109	from DTE	Data channel received line signal detector	W	113	from DTE	Transmitter signal element timing B-wire
H	108/1	from DTE	Connect data set to line	BB	—	—	F ₃
	108/2	from DTE	Data terminal ready	CC	—	—	F ₄
	125	to DTE	Calling indicator	DD	—	—	F ₅
K	—	—	F ₁	EE	—	—	F ₄
L	—	—	F ₂	FF	—	—	F ₅
M	—	—	F ₁	HH	—	—	N ₁
N	—	—	F ₂	JJ	—	—	N ₂
R	104	to DTE	Received data A-wire	KK	—	—	N ₁
T	104	to DTE	Received data B-wire	LL	—	—	N ₂
V	115	to DTE	Receiver signal element timing A-wire	MM	—	—	F
X	115	to DTE	Receiver signal element timing B-wire	NN	—	—	F
Y	114	to DTE	Transmitter signal element timing A-wire				

F = Pins reserved by ISO, not for national use.
Subscripts indicate pins to form pairs.

N = Pins permanently reserved for national use.
Pins HH, JJ and KK are used in the U.K. for transmitter-clock control.

30.10 RTTY Control Sequences (from CCITT Recommendation S.4)

Sequence	Meaning
ZCZC	start of message
NNNN	end of message
CCCC	enable remote reperforator (or other device)
SSSS	enable remote terminal
FFFF	disable remote reperforator
KKKK	ready for test
KLKL	enable remote reader
XXXXX	error signal