T+A   - IR-REMOTE CONTROL -

Preface

All **T+A** HiFi units from 1988 onwards use infra-red (IR) remote controls with the same command structure. All devices of the **T+A** AudioCon (AC) series, the R-series, the M-series and the K series can be controlled by the same set of commands.

A complete **T+A** system has only one central device (MASTER device) with an infra-red receiver. This MASTER-device is always the pre-amplifier, integrated amplifier or receiver. The master is linked to all other devices (= SLAVE devices). Typical slave devices are audio sources (CD-players, tuners, etc.) or A/V sources (DVD, Set Top Boxes etc.). Other examples of SLAVE devices are surround decoders, power-amps, active loudspeakers or remote display units. The master device analyses all IR-commands received and takes care that the commands are sent to the correct device. I.e.: amplifier commands (input selection. volume etc.) are executed by the master device itself. Source commands like STOP, PLAY, SKIP etc. are sent to the active listening source etc.

For the control of SLAVE devices different types of control interfaces were used:

    AudioCon (1988...1995)   **Audio-Con** interface (RS232)

    R - series
        1993...1999   **RC** interface (unidirectional 2 wire serial interface, 3.5 mm "headphone" jack)
        1999 onwards   **R-Link** interface (bi-directional 3 wire serial interface, RJ45); additional: RC interface for backwards compatibility)

    M-series   **M-Link** (bi-directional control + power supply bus, Sub-D 25)

Details of these interfaces are given in separate documents.

R-Link Source devices – "STAND-ALONE" operation
R-Link source devices can also be remote controlled when they are operated "stand alone" (without a **T+A** master). For this purpose they have an input for an external infra-red receiver. In stand-alone operation a few things have to be considered very carefully:

The **T+A** remote controls normally do not use an addressing scheme for different devices (like for example RC-5). → In a linked **T+A** system the master device does the addressing to control a specific device !

This leads to a problem when two **T+A** devices for example a CD-player and a tuner shall be operated and remote controlled in the same room. If for example the >| button is pressed, the CD will jump to next track and the tuner will switch to the next preset.
This problem can be solved by using the three address bits of the **T+A** IR-command (which are normally 000). One source device then is set to an alternate address by using the **T+A** Code Converter RC1 and using two remote controllers – one with the standard address, one set to the alternate address.

Command structure

Telegram

The **T+A** infra-red remote controllers send a command telegram for each press of a button. A telegram consists of a 10-bit start command (Start), one or more 10-bit commands (CMD) and a 10-bit end command (END). The command (CMD) is repeated at regular intervals as long as the button is pressed. The end command is sent *immediately* after the button is released. If the button is released during a command transmission, the transmission is finished first, then (after approx. 2...4 ms pause) the END command is sent immediately afterwards.
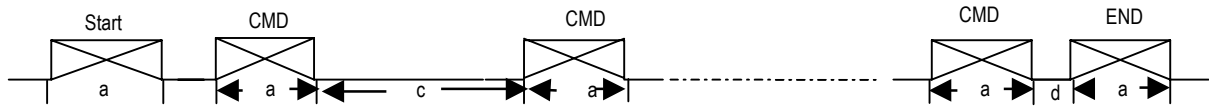

a := 13.312 ms	command (10 bits)
b := 19.968 ms	time interval between start command and first information command
c := 117,76	time interval between two information commands (key continuosly pressed)
d : > 2ms	time between last info command and end command (*)

> Note:
> **START** & **END** commands may be omitted, but this leads to a loss of precision when operating some functions. For example the VOLUME control can not be operated in extreme fine steps.

Command

For the commands a 10 bit bi-phase code with a preceding pre-bit and one start bit is used. The emitted IR light is modulated by a 31,25 kHz carrier. The structure of the commands is shown below:

	P	infra red pause	S	A	B	C	D	E	F	G	H	I
			1	0	1	1	0	0	1	0	0	0
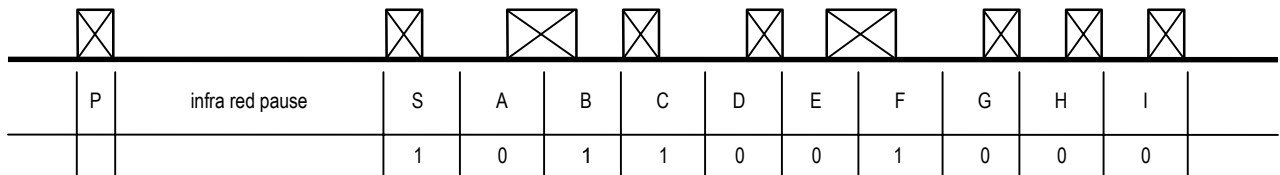
P	**pre-bit**	256 us - followed by a 2560 us infra-red pause
S	**start-bit** (always "1")	
A ... F	**command bits** (see table below)	bit length := 1024 us
G ... I	**address bits**	

Structure of modulated half bit
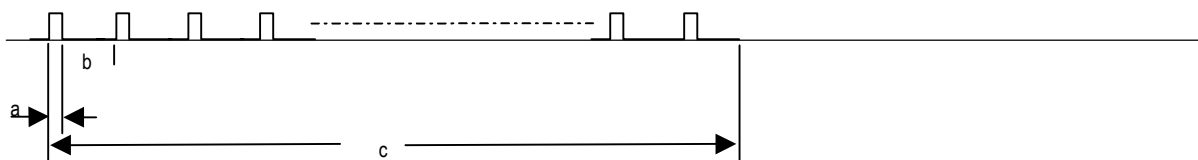
a :=	8 us	- IR pulse length
b :=	24 us	- IR pause
c :=	512 us	- modulated half of bi-phase bit (16 pulses)

IR modulation frequency := 31,25 kHz

Tolerances

For the timing of the IR signals a tolerance of +/- 1% is permitted.

Higher tolerances will result in poor results. Especially the bit-length of the bi-phase code (512 us+512 us = 1024us) should lie in the 1% tolerance range. For the IR-carrier frequency, the pause between commands, and the IR-pause following the pre-bit +/- 5% tolerance is permitted.

Command and address allocation

The allocation of commands (command-bits A...F) is given in the table below.

Start/End command: the start end command bit pattern is (A....I): 1 1 1 1 1 1 1 1 1

Adress bits G...I

The standard address (G...I) is 0 0 0

In case of IR-code "collisions" (some GRUNDIG TV sets use the same IR command structure), the address of the **T+A** system can be altered to 1 0 1

List of **T+A** remote control commands

F1	F11	F12	F2000	F800	ABCDEF	Description / Remarks	Colour
Amplifier Functions (Master)							
(⊙)	(⊙)	(⊙)	ON/OFF	(ON)	000001	ON/OFF short: master → ON slave: ON/OFF long (4 sec) system → OFF	
(CD)	(CD)	CD / DVD	CD	(CD)	100011	Input Select CD	
(AUX 3)			MM	(AUX)	011101	.. AUX3	
(AUX 2)			MC		100111	.. AUX2	
(TUNER)	(TUNER)	(TUNER)	TUNER	(TUNER)	010111	.. TUNER	
(TAPE 2)	(TAPE 2)	VCR	DAT	(CC)	010101	.. TAPE2	
(TAPE 1)	(TAPE 1)	TAPE	TAPE	(TAPE)	110101	.. TAPE1	
(TV)	(TV)	TV / STB	VIDEO		000111	.. TV	
(AUX1)	(AUX)	(AUX)	AUX	(AUX / P)	111101	.. AUX1	
(A 🔇)	(A 🔇)	(A 🔇)	SP A	(SP A)	011100	Speaker A ON/OFF	
(🔇 B)	(🔇 B)	(🔇 B)	SP B	(SP B)	111100	Speaker B ON/OFF	
(PRE)			PRE		001110	PREamp_Out ON/OFF	
(☼ / OFF)			OFF		101110	Speaker+PRE OFF (TV: Backlight ON/OFF)	
(VOL +)	(VOL +)	(VOL +)	VOLUME+	(VOL +)	000000	VOLUME +	
(VOL -)	(VOL -)	(VOL -)	VOLUME -	(VOL -)	100000	VOLUME -	
			BASS+		001000	Tone_Control BASS +	
			BASS -		101000	.. BASS -	
			TREBLE +		010000	.. TREBLE +	
			TREBLE -		110000	.. TREBLE -	
(FLAT)	(FLAT)	F1 / F2	FLAT		001100	FLAT TONE_CTRL ON/OFF	
(LOUDN)	(LOUDN)	LD/FLAT	LOUDN		101100	LOUDNess ON/OFF F12: short = Loud ON/OFF long = FLAT ON/OFF	
(SRND)	(SRND)	(SRND)		(SURROUND)	110111	SuRrouND	Green
(🌀 R)			BALA. R		011000	Wippe weiß, R	White
(L 🌀)			BALA. L		111000	Wippe weiß, L	
(◁◦🌀)				(◀)	100010	Wippe gelb, L	
(◦🌀▷)	(AMP)	(AMP)		(▶)	001010	AMPlifier & Decoder – Menu short: main menu long (4sec): setup-menu	Yellow
Source Functions (Slave)							
(◎△)	(SRC)	(SRC)		(▲)	011111	SouRCe-Menu short: main menu / disc menu long (4sec): setup-menu	Blue
(STOP)	(■)	(■)	STOP	(STOP)	100100	STOP	
(PAUSE)	(❚❚)	(❚❚)	PAUSE	(PAUSE)	000101	PAUSE	
(PLAY)			PLAY	(PLAY)	010010	PLAY	
(▶❘)	(▶❘)	(▶❘)	>❘	(▶❘)	110100	Next & Cursor up in STOP: start play	
(❘◀)	(❘◀)	(❘◀)	❘<	(❘◀)	101010	Prev. & Cursor down	
(▶▶)	(▶▶)	(▶▶)	>>	(▶▶)	100101	Fast FWD & Cursor >	
(◀◀)	(◀◀)	(◀◀)	<<	(◀◀)	011010	Fast REV & Cursor <	
(OK)	(OK)	(OK)	PROG	(PROG)	100110	OK / PROGram (Enter)	
(0)	(0)	(0)	0	0	000011	0	
(1)	(1)	(1)	1	1	111010	1	
(2)	(2)	(2)	2	2	000110	2	
(3)	(3)	(3)	3	3	010110	3	
(4)	(4)	(4)	4	4	000010	4	
(5)	(5)	(5)	5	5	001001	5	
(6)	(6)	(6)	6	6	111011	6	
(7)	(7)	(7)	7	7	110001	7	
(8)	(8)	(8)	8	8	010001	8	
(9)	(9)	(9)	9	9	111001	9	

Special TV and AudioCon functions (Slave)							
(TV ▣)			RECORD		001011	TV: Teletext	FB_REC
(M)			SOURCE	(SRC)	001111	TV: Menu	FB_SRC
(?)				(AMP)	111111	TV: ?	FB_AMP
			MUTING		010011	Muting	<mark>FB_MUTE</mark>
(A)			ATTN		101011	A (Attenuator)	FB_ATTN
(B)			AM/FM		101001	B (AM/FM)	FB_AMFM
(C / ▨)			SKIP/C	(S/C)	101101	C (Skip/Cancel)	FB_SKIP
(↰)			REPEAT		110110	REPEAT	FB_REPE
(M-PRG)			MO/ST		100001	M-PRG (Mono/Stereo)	FB_MOST
(◀▶)			WD/NARR		001101	<> (Wide/Narr)	FB_WDNR
(PIP)			Record (r)		110010	PIP / REC	FB_RECORD
(AV)			STORE		011110	AV / STORE	FB_STORE
(USER)			USER		111110	CH / USER	FB_USER
(▽◎)				(▼)	101111	Wippe blau, L	FB_ARDN