1 Outline

1.1 Connection

5 wire system

	TxD	Transpose	-------->	RxD	
	RxD	receive	<-------	TxD	
RX-V1	GND	Ground	---------	GND	AMX etc.
slave	CTS	permit to send data	<-------	RTS	master
	RTS	request to send data	-------->	CTS	

*When not connected, data sending to RX-V1 is prohibited (CTS port pull down).

1.2 Communication format

based on RS-232C format

Full duplex, start-stop synchronization communication
Baud rate : 9600bps
Data bits : 8
Parity : No
Stop bit : 1bit
Handshaking : Hardware

*RTS is low when the power plug is not plugged into the AC outlet.
If RTS keeps low for more than 10 seconds even if the power plug is connected to the AC outlet, there may be some problems in the system.

1.3 Data block timeout

The data transmission takes at most 500ms for every reports from RX-V1.
If the data transmission won't end within 500ms, please make it timeout.
The system may have some problems.

2 Start transactions

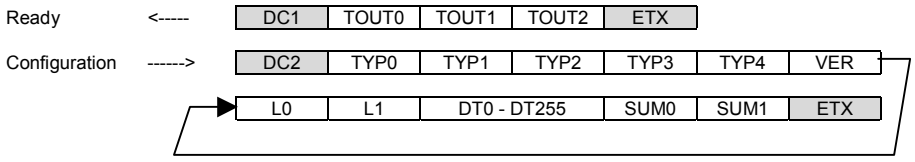
*Start of the communication

1) <------ Ready — Please send the Ready at the start of the communication. Ready sets the timeout of the communication. (001 = 1ms, 002 = 2ms , ..., FFF = 4095ms)

Slave (RX-V1) — Host (AMX etc)

2) ------> Configuration — Configuration includes Model ID, software version, setting data of the RX-V1.

*Please retry sending data if RX-V1 won't send back Configuration within 1 second after the Host sent Ready to the RX-V1.
In case the RX-V1 won't send back a Configuration after the Host sent Ready 5 times, please do not send any further data.
*RX-V1 can execute the start transactions even when the system status is Busy.
*RX-V1 sends Configuration after the MCU reset, even if it is not requested by the Host.



*TYPx : Model ID
*VER : Software Version
*SUM : 2's complement of the sum of all data (not including header and footer)

function name	function	data (ASCII)	range (HEX)
TOUT0 - 2	communication timeout	0 - 9, A - F	0 - 0xFFF

*timeout between the header and the footer
*timeout=0 means no timeout

function name	function	data (ASCII)	range (HEX)
TYP0 - 4	model ID	0 - 9, A - F	voluntary
VER	software version	A - Z	voluntary
L0 - 1	data length	0 - 9, A - F	1 - 0xFF
DT0 - 255	data	0 - 9, A - F	0 - 0xF
SUM0	upper 4 bit if SUM	0 - 9, A - F	0 - 0xF
SUM1	lower 4 bit of SUM	0 - 9, A - F	0 - 0xF

*Structure of the data in Configuration command (DT0～DTxx)

data	When the power is OFF, only DT0 and DT1 are sent to the Host.		
DT0	0/1	System	OK/Busy
DT1	0/1	Power	OFF/ON
DT2	0 - C	Input	PHONO/CD/TUNER/TAPE/MD/DVD/LD/D-TV/CBL-SAT/VCR1/VCR2/VCR3/V-AUX
DT3	0/1	6ch input	OFF/ON
DT4	0 - 4	Input Mode	AUTO/D.D.RF/DTS/DIGITAL/ANALOG/ANALOG ONLY
DT5	0/1	Audio Mute	OFF/ON
DT6	0 - C	Zone2 Input	PHONO/CD/TUNER/TAPE/MD/DVD/LD/D-TV/CBL-SAT/VCR1/VCR2/VCR3/V-AUX
DT7	0/1	Zone2 Mute	OFF/ON
DT8	0 - F	Master Volume	Upper 4 bit
DT9	0 - F	Master Volume	Lower 4 bit
DT10	0 - F	Zone2 Volume	Upper 4 bit
DT11	0 - F	Zone2 Volume	Lower 4 bit
DT12	0 - F	Program	Upper 4 bit
DT13	0 - F	Program	Lower 4 bit
DT14	0/1	Effect	OFF/ON
DT15	0/1	6.1/ES key status	OFF/ON
DT16	0 -2	OSD	FULL/SHORT/OFF
DT17	0 - 3	Sleep	120/90/60/30/OFF
DT18	0 - 4	Tuner Page	A/B/C/D/E
DT19	0 - 7	Tuner No.	1/2/3/4/5/6/7/8
DT20	0 - 6	Home bank	Main/A/B/C/D/E/F
DT21	0 - 6	Volume bank	Main/A/B/C/D/E/F
DT22	0/1	Speaker relay A	OFF/ON
DT23	0/1	Speaker relay B	OFF/ON
DT24	0 - 8	Playback	6ch input/Analog/PCM/DD*(except 2.0)/DD(2.0)/DD.Karaoke/DD.EX/DTS/DTS-ES/DIGITAL
DT25	0 - 7	Fs	Analog/32kHz/44.1kHz/48kiHz/64kHz/88.2kHz/96kHz/Unknown
DT26	0/1	6.1/ES playback	OFF/ON
DT27	0/1	Thr / Bypass	Normal / Bypass
DT28	0/1	RED dts	Release/Wait
DT29	0/1	Head Phone	OFF/ON

*DD = Dolby Digital

3 Commands

*Control commands

(Slave) (Host) control commands from external instruments
RX-V1 <------ control commands AMX etc

*RX-V1 accepts control commands only while the power is on.
(except for Power commands and System commands*)

*Please do not send control commands while the system status is 'Busy'. RX-V1 can receive Control Commands only when the system status is 'OK'.

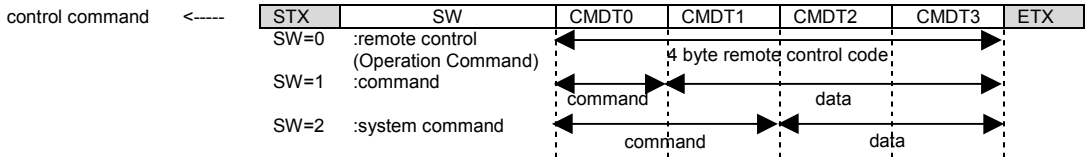
*Host cannot cancel the commands that have already been sent to the RX-V1.
Please set the old value again when you need to cancel the command.

*Please send the same command if the RX-V1 won't reply any data within 1sec.
When the number of reply exceed 5, please send 'Ready' and restart the communication again.

*The Switch (SW) byte sets the type of the control.
When the SW is set to '0', The Control Commands act as the remote control commands.

*If one setting changed before RX-V1 sends a Report Command, RX-V1 report
For example, If a user set the input selector in the unit to LD just after the host send commands to change input to CD, RX-V1 report only that the input was changed to LD by the system operation.

*System command, **Report command --> described in later in this papers



function name	function	data (ASCII)	renge (HEX)
SW	command switch	0 - 9	0 - 9
CMDT0 - 3	command & data	0 - 9, A - F	variable

*Changing the SW, the data number of the command/data can be varied.
SW=0 : 4 byte command for remote control code
SW=1 : 1 byte command 0 - F (HEX expression in ASCII)
SW=2 : 2 byte command 10 - FF (HEX expression in ASCII)

*System Command

*System Commands

	command			data			Report Command		
SW	CMD T0	CMDT 1		CDMT 2	CMDT 3		Type	RCMD1, 2	RDAT1, 2
2	0	0	report command enable	0	0	enable	0	00	00(OK)
				0	1	disable	0	00	00(OK)
	0	1	time between two report commands	0	0	real time	0	00	00(OK)
				0	1	50ms	0	00	00(OK)
				0	2	100ms	0	00	00(OK)
				0	3	150ms	0	00	00(OK)
				0	4	200ms	0	00	00(OK)
				0	5	250ms	0	00	00(OK)
				0	6	300ms	0	00	00(OK)
				0	7	350ms	0	00	00(OK)
				0	8	400ms	0	00	00(OK)

*Operation Command

Operation commands work as remote control commands.

*Operation Commands

Operation Command							Report Command	
SW	CMDT	CMDT	CDMT	CMDT	function	setting	Type	RCMD1,2
0	7	A	1	A	master volume	Up	0	26
	7	A	1	B		Down		
	7	E	A	2	master volume Mute	ON		23
	7	E	A	3		OFF		
	7	A	1	4	Input	PHONO		21
	7	A	1	5		CD		
	7	A	1	6		TUNER		
	7	A	1	8		TAPE		
	7	A	C	9		MD		
	7	A	1	7		LD		
	7	A	C	1		DVD		
	7	A	5	4		D-TV		
	7	A	C	0		CBL/SAT		
	7	A	0	F		VCR1		
	7	A	1	3		VCR2		
	7	A	C	8		VCR3		
	7	A	5	5		V-AUX		
	7	E	A	4	6ch input	ON		
	7	E	A	5		OFF		
	7	E	A	6	Input Mode	AUTO		22
	7	E	A	7		D.D.RF		
	7	E	A	8		DTS		
	7	E	A	9		DIGITAL		
	7	E	A	A		ANALOG		
	7	A	D	A	Zone2 volume	Up		27
	7	A	D	B		Down		
	7	E	A	0	Zone2 mute	ON		25
	7	E	A	1		OFF		
	7	A	D	0		PHONO		
	7	A	D	1		CD		
	7	A	D	2		TUNER		
	7	A	D	3		TAPE		
	7	A	C	F		MD		
	7	A	D	5		LD		
	7	A	C	D		DVD		
	7	A	D	9		D-TV		
	7	A	C	C		CBL/SAT		
	7	A	D	6		VCR1		
	7	A	D	7		VCR2		
	7	A	C	E		VCR3		
	7	A	D	8		V-AUX		
	7	A	1	D	Power	ON		20
	7	A	1	E		OFF		
	7	E	B	0	On screen(OSD)	OFF		2B
	7	E	B	1		SHORT		
	7	E	B	2		FULL		
	7	E	B	3	Sleep	OFF		2C
	7	E	B	4		120		
	7	E	B	5		90		2D
	7	E	B	6		60		
	7	E	B	7		30		
	7	E	B	8	6.1/ES Key	ON		
	7	E	B	9		OFF		
	7	E	E	0	effect	OFF		28
	7	E	E	1		Hall A		
	7	E	E	2		Hall B		
	7	E	E	3		Hall C		
	7	E	E	4		Hall D		
	7	E	E	5		Hall E		
	7	E	E	6		Live Concert		
	7	E	E	7		Tokyo		
	7	E	E	8		Freiburg		
	7	E	E	9		Royaumont		
	7	E	E	A		Village Gate		
	7	E	E	B		Village Vanguard		
	7	E	E	C		The Bottom Line		
	7	E	E	D		The Roxy Theatre		
	7	E	E	E		Warehouse Loft		
	7	E	E	F		Arena		
	7	E	F	0		Disco		
	7	E	F	1		Party		
	7	E	F	2		Game/Amusement		
	7	E	F	3		Pop/Rock		
	7	E	F	4		DJ		
	7	E	F	5		Classical/Opera		
	7	E	F	6		Pavilion		
	7	E	F	7		Mono Movie		
	7	E	F	8		Variety Sports		
	7	E	F	9		Spectacle		
	7	E	F	A		Sci-Fi		
	7	E	F	B		Adventure		
	7	E	F	C		General		
	7	E	F	D		Normal		
	7	E	F	E		Enhanced		
	7	A	E	0	Tuner preset page	A		29
	7	A	E	1		B		
	7	A	E	2		C		
	7	A	E	3		D		
	7	A	E	4		E		
	7	A	E	5	Tuner preset No.	1		2A
	7	A	E	6		2		
	7	A	E	7		3		
	7	A	E	8		4		
	7	A	E	9		5		
	7	A	E	A		6		
	7	A	E	B		7		
	7	A	E	C		8		

SW	CMDT	CMDT	CDMT	CMDT	function	setting	Type	RCMD
0	7	E	A	B	speaker relay A	ON	0	2E
	7	E	A	C		OFF		
	7	E	A	D	speaker relay B	ON		2F
	7	E	A	E		OFF		
	7	E	2	0	Home bank	Main		30
	7	E	2	1		A		
	7	E	2	2		B		
	7	E	2	3		C		
	7	E	2	4		D		
	7	E	2	5		E		
	7	E	2	6		F		
	7	E	2	B	Home preset memory	A		
	7	E	2	C		B		
	7	E	2	D		C		
	7	E	2	E		D		
	7	E	2	F		E		
	7	E	3	0		F		
	7	E	3	5	Home preset recall	A		
	7	E	3	6		B		
	7	E	3	7		C		
	7	E	3	8		D		
	7	E	3	9		E		
	7	E	3	A		F		
	7	E	6	0	Volume bank	Main		31
	7	E	6	1		A		
	7	E	6	2		B		
	7	E	6	3		C		
	7	E	6	4		D		
	7	E	6	5		E		
	7	E	6	6		F		
	7	E	6	B	Volume preset memory	A		
	7	E	6	C		B		
	7	E	6	D		C		
	7	E	6	E		D		
	7	E	6	F		E		
	7	E	7	0		F		
	7	E	7	5	Volume preset recall	A		
	7	E	7	6		B		
	7	E	7	7		C		
	7	E	7	8		D		
	7	E	7	9		E		
	7	E	7	A		F		

4 Reset Command

*This command resets all settings to factory presets.

Slave (RX-V1) <------ reset Host (AMX etc)

*After the system has been reset, please sent Ready and restart the communication.

Ready	<-----	DC3	DEL	DEL	DEL	ETX	*recall factory preset of all data

5 Report Command

*Reports which informs the change of settings controlled by the control command, remote controller or keys in the unit.

RX-V1 ------> Report command AMX etc

*There are three types of Report Commands
System status report : system information (Busy, OK, etc)
Playback status report : source and decoding information (audio format, sample rate(Fs), etc)
Operation report : setting information (Input, DSP Program, etc)
*RX-V1 reports the "Power Off" report (System state report), when a control command except for the Ready, Power control, and System command is sent to RX-V1.
*RX-V1 reports the Guard status, which indicates if transaction is prohibited or not, and what is prohibiting the transaction when the guard is on.
*RX-V1 send only one Report command for each types of control after the control command is sent to RX-V1, which reports the last state of the setting as a result of the series of transactions.
For example, If a user set the input selector in the unit to LD just after the host send commands to change input to CD, RX-V1 report only that the input was changed to LD by the system operation.

function name	function	data (ASCII)	range (HEX)
TYP	control type	0 - 9	0 - 9
GRD	guard status	0 - 9	0 - 9
RCMD0, 1	command	0 - 9, A - F	0 - 0xFF
RDAT0, 1	data	0 - 9, A - F	0 - 0xFF

<Control type> This indicates for which type of control the report command is.

TYP	control type
0	control by RS-232C
1	control by remote controller (I/R)
2	control by keys in the unit
3	control by system
4	control by encoder

<Guard status> This indicates guard status against all control command

GRD	Guard status
0	no guard
1	guarded by system
2	guarded by setting

*Factor of the guards and the contents informed in report commands when there are no guards

operation	no guard	system guard	setting guard
Power	Power status	---	---
Input	6ch input/ selected input		---
Input mode	selected Input mode	6ch Input is ON during Input Rename function doesn't have the designated Input mode	---
Zone2 Input	selected input	zone2 selector is not at "REMOTE"	---
Mute	mute status	---	---
Zone2 mute	mute status	---	---
master volume	volume value	---	---
Zone2 volume	volume value	---	Zone2 volume is set to "FIX"
Program	Program ID	6ch input is ON source is not 32kHz,44.1kHz or 48kHz	---
6.1/ES Key	status	6ch input is ON Program is OFF	---
Tuner page	page	Tuner function is not active	---
Tuner Preset No.	No.	Tuner function is not active	---
OSD	status	SETMENU is active Test tone is ON	Memory Guard is ON
Sleep	status	Test tone is ON	---
Home	selected Bank	---	---
Home volume	selected Bank	---	---
Speaker A/B	ON/OFF Status	Headphone Mode	---

<Contents of report>

*System status reports

RCMD0, 1	content	RDAT0, 1	state	
00	no guard	00	OK	ready for accepting the control commands
		01	Busy	start of the term prohibits sending commands
		02	Power Off	report against the command which cannot be accepted when the Power is Off

*RX-V1 sends this report when the system is reset or the power turns off.
It can be used for observation of the system revival.

01	warning	00	over current	report of abnormal states
		01	DC Detect	(Only when it's possible to report)
		02	power trouble	
		03	over heat	

*Playback status reports

RCMD0, 1	content	RDAT0, 1	state	
10	Playback	00	external decoder	
		01	Analog	
		02	PCM	
		03	D.D.(except for 2/0)	audio code mode excepting for 2/0
		04	D.D.(2/0)	audio code 2/0
		05	D.D.karaoke	
		06	D.D.6.1	
		07	DTS	
		08	DTS.ES	
		09	Digital	waiting to decode, etc.
11	Fs	00	Analog	
		01	32kHz	
		02	44.1kHz	
		03	48kHz	
		04	64kHz	
		05	88.2kHz	
		06	96kHz	
		07	Unknown	
12	6.1/ES	00	ON	6.1/ES Playback status
		01	OFF	
13	Thr / Bypass	00	Normal	DSP Through status
		01	Bypass	
14	RED dts	00	Release	RED dts status*
		01	Wait	

*After the signals of DTS CD or DTS LD are stopped, the RED dts status keeps "Wait" for 30 sec., then turned to "Release"

*While the RED dts is "Wait", this can be released by changing the Input Mode.

*Operation reports

RCMD0, 1	content	RDAT0, 1	state
20	Power	00	OFF
		01	ON
21	Input	x,0	PHONO
		x,1	CD
		x,2	TUNER
		x,3	TAPE
		x,4	MD
		x,5	DVD
		x,6	LD
		x,7	D-TV
		x,8	CBL/SAT
		x,9	VCR1
		x,A	VCR2
		x,B	VCR3
		x,C	V-AUX
		0/1,x	6ch input OFF/ON
22	Input mode	00	AUTO
		01	D.D.RF
		02	DTS
		03	DIGITAL
		04	ANALOG
		05	ANALOG ONLY
23	Mute	00	OFF
		01	ON
24	Zone2 Input	00	PHONO
		01	CD
		02	TUNER
		03	TAPE
		04	MD
		05	DVD
		06	LD
		07	D-TV
		08	CBL/SAT
		09	VCR1
		0A	VCR2
		0B	VCR3
		0C	V-AUX
25	Zone2 Mute	00	OFF
		01	ON
26	Master volume	00	-oo
		01	-99dB
		02	-98.5dB
		....	....
		C7	0dB
27	Zone2 volume	00	-oodB
		01	-79dB
		02	-78dB
		....	....
		50	0dB
28	Program	80	OFF
		00	Hall A
		01	Hall B
		02	Hall C
		04	Hall D
		05	Hall E
		06	Live Concert
		08	Tokyo
		09	Freiburg
		0A	Royaumont
		0C	Village Gate
		0D	Village Vanguard
		0E	The Bottom Line
		10	The Roxy Theatre
		11	Warehouse Loft
		12	Arena
		14	Disco
		15	Party
		16	Game/Amusement
		18	Pop/Rock
		19	DJ
		1C	Classical/Opera
		1D	Pavilion
		20	Mono Movie
		21	Variety Sports
		24	Spectacle
		25	Sci-Fi
		28	Adventure
		29	General
		2C	Normal
		2D	Enhanced

RCMD0, 1	content	RDAT0, 1	state
29	Tuner Page	00	A
		01	B
		02	C
		03	D
		04	E
2A	Tuner Preset No.	00	1
		01	2
		02	3
		03	4
		04	5
		05	6
		06	7
		07	8
2B	OSD	00	FULL
		01	SHORT
		02	OFF
2C	SLEEP	00	120
		01	90
		02	60
		03	30
		04	OFF
2D	6.1/ES Key	00	OFF
		01	ON
2E	Speaker relay A	00	OFF
		01	ON
2F	Speaker relay B	00	OFF
		01	ON
30	Home bank	00	Main
		01	A
		02	B
		03	C
		04	D
		05	E
		06	F
31	Home Preset memory	01	A
		02	B
		03	C
		04	D
		05	E
		06	F
32	volume bank	00	Main
		01	A
		02	B
		03	C
		04	D
		05	E
		06	F
33	Volume Preset Memory	01	A
		02	B
		03	C
		04	D
		05	E
		06	F
34	Head Phone	0	OFF
		1	ON

Attentions

*When the Input is changed, RX-V1 sends Operation Report for Input (RCMD0,1="21") and Input mode(RCMD0,1="22").

*When the Home bank is changed, RX-V1 sends Operation Report for Home bank (RCMD0,1="30") and Configuration Command.

*When a headphone is plugged into the headphone jack and Speaker Relay turned off, RX-V1 send the Operation Report for Speaker Relay A and B (RCMD0,1="2E","2F", RDAT="00(OFF)"). RX-V1 sends the Operation Command for Speaker Relay A and B when the headphone is jacked off, too.

*Each time the source from the Inputs or playback status (ex. 6.1/ES, RED dts etc.) of the system changes, RX-V1 send the Playback Status report.

*Each time the busy status of the system change, RX-V1 send the System Status report.

Communications

[1] No connection of the AC Outlet of the RX-V1 / no connection of RS-232C cable

Because RX-V1 can not send a configuration after the 5th re-sending of Ready, please let host report trouble.

RX-V1 <----X------ AMX etc

[2] AC outlet / RS-232C cable is plugged off after the communication has started

In this case, when host detected a data block timeout or 5th re-sending, please let host prohibit publishing any commands and clear send buffer. After that, re-start communication from sending Ready (start transactions) and check the [1].

However this cannot be detected when the report command is set to disable.

When the RS-232C cable is plugged off, though RX-V1 try to send report commands for the operations by the remote controller or keys, the reports data are only stocked in the send buffer, which make it overflow.

When the send buffer overflowed, RX-V1 clears the send buffer and stop sending report commands.

*In this case, RX-V1 sends no report commands even after the RS-232C cable is re-connected.

Please plug off and on the AC outlet, or re-start communication from sending Ready (start transactions).

[3] AC outlet is plugged in after [1],[2]

RX-V1 report that the system is reset.

When the host receives the report, please let host send Ready to start communication.

[4] Host turns on after the RX-V1 turned on

After confirming existence of RX-V1 by Configuration, control command can be sent to RX-V1.

However, RX-V1 can accept only System command and power command when the power is Off, and can accept no report commands for other operations.

When communication errors (timeout etc.) occur during the start transactions, the same process as [1] is needed, and the factors of the errors are failures of RX-V1 or bugs of software.

RX-V1		AMX etc	
	<----------	Ready	] start transactions
Configuration	---------->		
	<----------	Set enable/disable report command	
	<----------	control command	
(report command	---------->	) ; depends on the setting	

[5] Error transactions after [4]

When host detect a timeout of report command or 5th re-sending of control command, please clear the send buffer and re-start from the start transactions.

6 Appendix

* ASCII Chart

	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	I	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	EXC	+	;	K	[	k	{
C	FF	FS	,	<	L	¥	l	|
D	CR	GS	-	=	M	]	m	}
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	DEL

* the column number = the first hexadecimal digit
  the row number = the second hexadecimal digit

* The characters in the gray sells are available in the RS-232C communications.