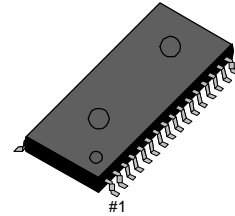


GENERAL DESCRIPTION

The S1A0501X01 is an audio processor for volume/tone/fader control, which is suitable for car radios or Hi-Fi system. It has a built-in trimmer for user to set a source level. R/L rear output is changable to input in the case of a home audio system for user convenience, an external equalizer or a noise reduction circuit is selectable.

When the S1A0501X01 is used with some sound-effect equipment such as graphic equalizer, the internal tone control block of S1A0501X01 can be bypassed for decreasing redundancy. All selections and function controls are designed to be controlled by an I²C-bus protocol or a general microprocessor interface protocol.

32-SOP-450B



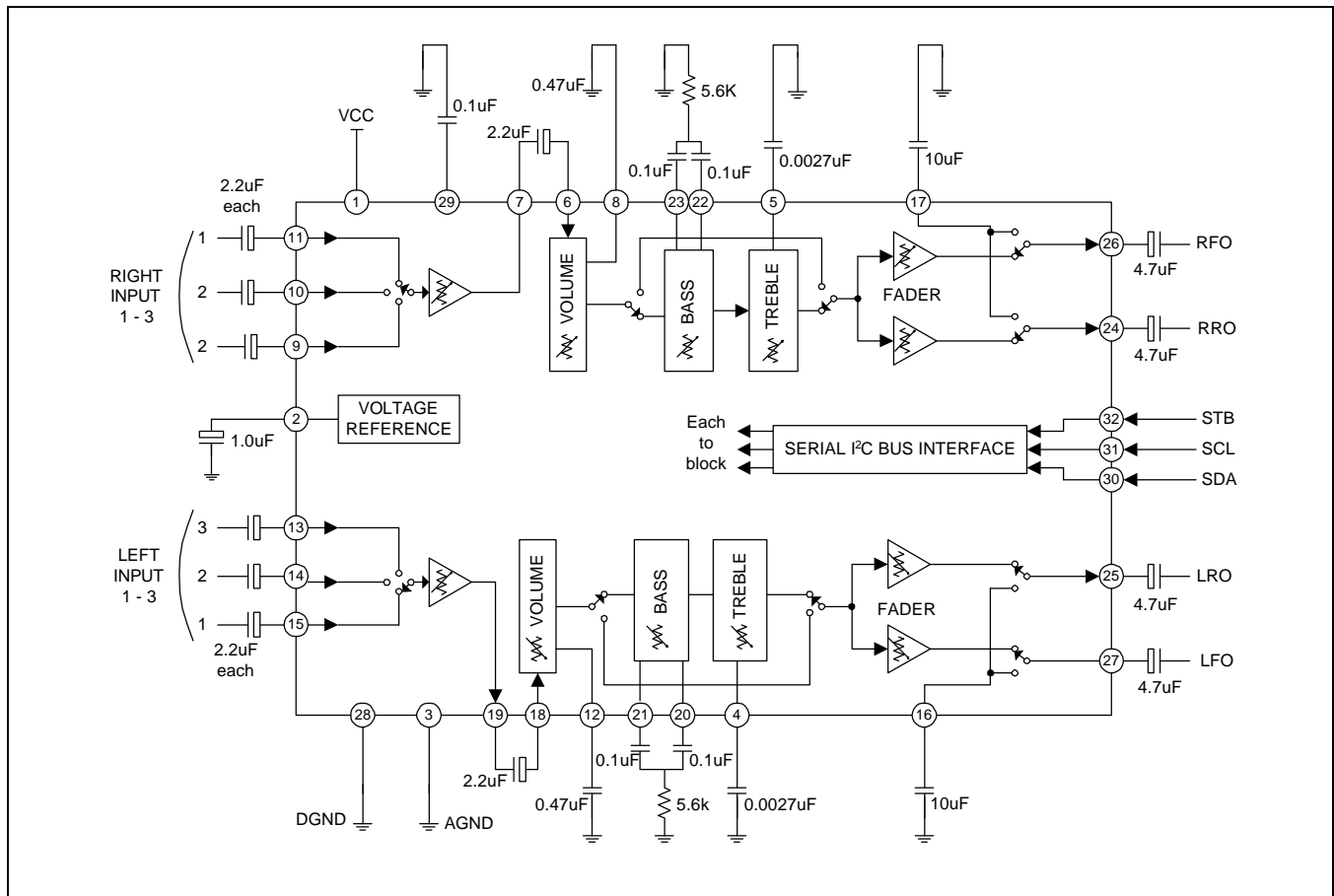
FEATURES

- 3-Input multiplexing
- Source Level trimmer (selectable input level)
- Volume control in 0.6dB step
- Tone control (internal bass/treble function block with external components)
- Source out / volume in (enable ext.graphic eq./ noise reduction equipment)
- Loudness / mute
- Fader control (separated for balance)
- All functions are programmable / controllable via serial I²C bus or general Micom interface protocol.

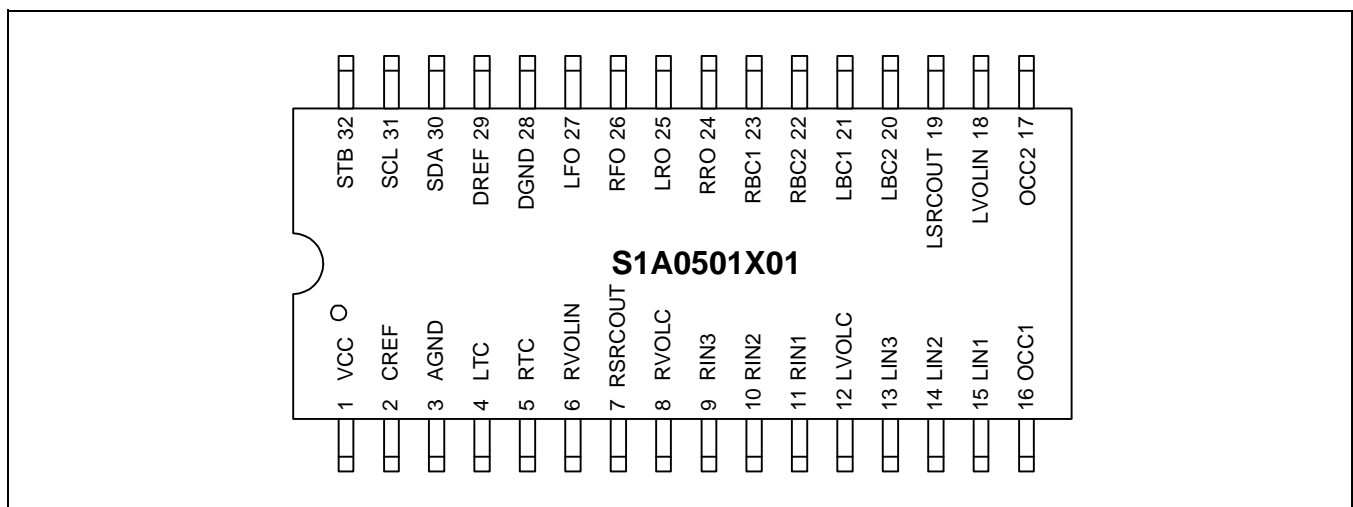
ORDERING INFORMATION

| Device | Package | Operating Temperature |
|-----------------|-------------|-----------------------|
| S1A0501X01-S0B0 | 32-SOP-450B | -25°C - +75°C |

BLOCK DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTION

| Pin | Symbols | Description |
|-----|---------|--|
| 1 | VCC | Power Supply |
| 2 | CREF | Reference Voltage Ripple Rejection Capacitor Tab |
| 3 | AGND | Analog Ground (0V) |
| 4 | LTC | Left Treble Capacitor Tab |
| 5 | RTC | Right Treble Capacitor Tab |
| 6 | RVOLIN | Right Volume In / External Equalizer For Right Channel |
| 7 | RSRCOUT | Right Source Out / External Equalizer For Right Channel |
| 8 | RVOLC | Right Volume Loudness Capacitor Tab |
| 9 | RIN3 | Right Audio Input3 |
| 10 | RIN2 | Right Audio Input2 |
| 11 | RIN1 | Right Audio Input1 |
| 12 | LVOLC | Left Volume Loudness Capacitor Tab |
| 13 | LIN3 | Left Audio Input3 |
| 14 | LIN2 | Left Audio Input2 |
| 15 | LIN1 | Left Audio Input1 |
| 16 | OCC1 | Offset Cancelling Capacitor Tab1 |
| 17 | OCC2 | Offset Cancelling Capacitor Tab2 |
| 18 | LVOLIN | Left Volume In / External Equalizer For Left Channel |
| 19 | LSRCOUT | Left Source Out / External Equalizer For Left Channel |
| 20 | LBC2 | Left Bass Capacitor Tab2 |
| 21 | LBC1 | Left Bass Capacitor Tab1 |
| 22 | RBC2 | Right Bass Capacitor Tab2 |
| 23 | RBC1 | Right Bass Capacitor Tab1 |
| 24 | RRO | Right Rear Audio Output |
| 25 | LRO | Left Rear Audio Output |
| 26 | RFO | Right Front Audio Output |
| 27 | LFO | Left Front Audio Output |
| 28 | DGND | Digital Ground (0V) |
| 29 | DREF | Internally-generated Digital Power Stabilization Capacitor Tab |
| 30 | SDA | Data Signal Input Of I ² C Bus |
| 31 | SCL | Clock Signal Input Of I ² C Bus |
| 32 | STB | Strobe Signal Input |

ABSOLUTE MAXIMUM RATINGS

| Parameters | Symbols | Value | Unit |
|---------------------------|---------|--------------|------|
| Supply Voltage | VCCmax | 15.0 | V |
| Max.Power Dissipation | Pdmax | 1000 | mW |
| Max.Operating Temperature | Topr | -25 to +75 | |
| Max.Storage Temperature | Tstg | - 40 to +125 | |

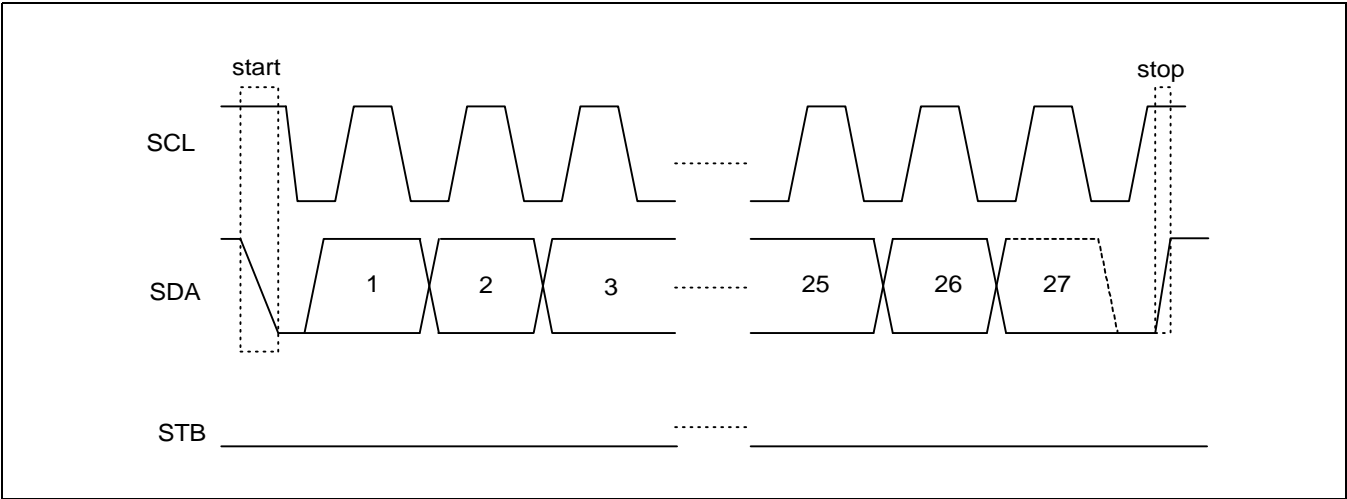
ELECTRICAL CHARACTERISTICS

Electrical Characteristics (Vi = 1Vrms/1kHz, Ta=25°C, VCC=13.2V TYP)

| Parameters | Test Conditions | Specifications | | | Unit |
|--------------------------|---------------------------------|----------------|-------|--------|------|
| | | Min | Typ | Max | |
| Operating Voltage | - | 6.0 | - | 15.0 | V |
| Supply Current | Vi=0 | 6.0 | 10.0 | 14.0 | mA |
| Input Dynamic | VCC=13.2V, Output T.H.D.=0.1% | 6.0 | - | - | Vp-p |
| Input Crosstalk | Vi=1Vrms,1kHz, 20Hz-20kHz BPF | - | - | -89.0 | dB |
| Trimming Range | - | -5.4 | -6.0 | - | dB |
| Channel Crosstalk | Vi=1Vrms,1kHz, 20Hz-20kHz BPF | - | - | -89.0 | dB |
| Channel Balance | Vi=1Vrms,1kHz | -2.0 | - | 2.0 | dB |
| Voltage Gain | Vi=1Vrms,1kHz, Volume=Max | -2.0 | 0.0 | 2.0 | dB |
| S/N Ratio | Vi=1Vrms,1kHz, 20Hz-20kHz BPF | | - | 92 | dB |
| T.H.D. | Vi=1Vrms,1kHz, Volume=Max | - | 0.005 | 0.01 | % |
| Loudness Boost | Vi=1Vrms,100Hz | 0.2 | - | 10.5 | dB |
| Max.Volume attenuation | Vi=1Vrms,1kHz, Volume=Min | | -76.2 | -74.2 | dB |
| Bass Control Range | Vi=1Vrms,100Hz, Bass= Min/Max | -14 | - | 14 | dB |
| Treble Control Range | Vi=1Vrms,10kHz, Treble= Min/Max | -12 | - | 12 | dB |
| Front/Rear Balance | Vi=1Vrms,1kHz, Fader= Middle | - | - | 1.0 | dB |
| Front/Rear Control Range | Vi=1Vrms,1kHz, Fader= Min | - | - | -38.75 | dB |
| Frequency Response | -3dB | 20 | - | 20000 | Hz |
| Mute Attenuation | Vi=1Vrms,1kHz, 20Hz-20kHz BPF | -100 | - | -90 | dB |

SERIAL BUS INTERFACE PROTOCOL - THE I²C BUS

Timing Diagram of I²C Bus Protocol



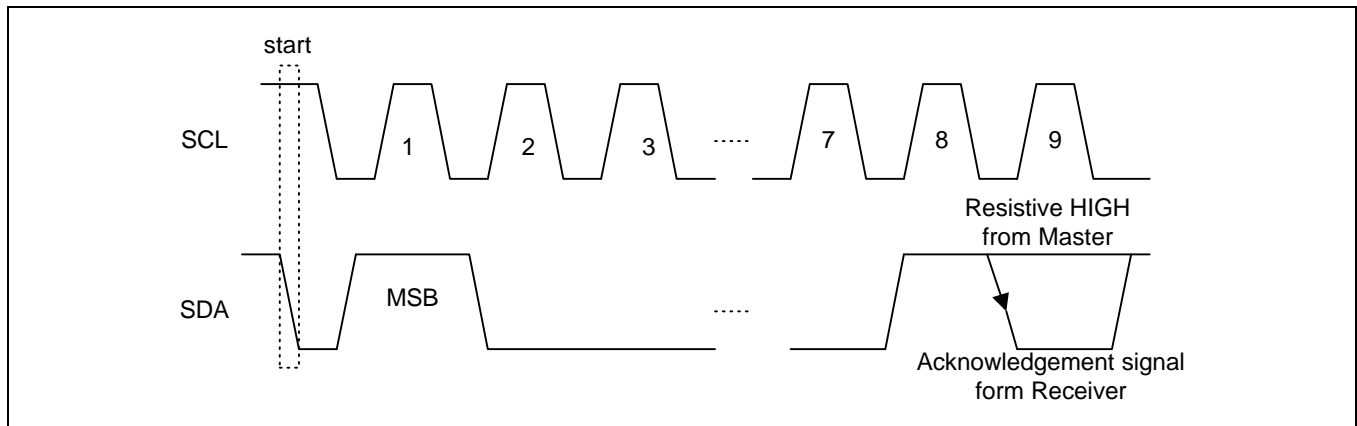
I²C Bus Byte Format of S1A0501X01

| Start | 1 - 8 | 9 | 10 - 17 | 18 | 19 - 26 | 27 | Stop |
|-------|---------------|-----|-------------|-----|---------|-----|------|
| S | Slave Address | ACK | Sub Address | ACK | DATA | ACK | P |

- S = A start Condition
- Slave Address = Chip Address (10000000B)
- ACK = Acknowledge (from Slave)
- Sub Address = Transferred Data1 (assigning Function)
- DATA = Transferred Data2 (assigning Operation)
- P = A Stop Condition

STB Signal 'LOW' '= Always 'LOW' when I²C Bus protocol (tied to 'GND').

♣ Max.SCL Frequency 200kHz

Acknowledge on the I²C Bus Interface Protocol

Software Specification of S1A0501X01

<< Byte Organization - I²C Bus Transmission >>

| FUNCTIONS | | SUB Address | DATA BYTE | | | | | | | | REMARKS | |
|-------------------|-------------|-----------------|------------------------|-----|-----|-----|-----|----|----|-----|---------------------------|---------------|
| | | | MSB | B6 | B5 | B4 | B3 | B2 | B1 | LSB | | |
| Input Control | Select | 0 0 0 X X X X X | SSEL SSEL X X X 1 0 | | | | | | | | | |
| | Trimmer Set | | STS1 STS0 X X X | | | | | | | | | |
| | Loudness | | SLD X X X | | | | | | | | | |
| Volume Control | Fine | 0 0 1 X X X X X | SVF3 SVF2 SVF1 SVF0 X | | | | | | | | | |
| | Coarse | | SVC2 SVC1 SVC0 X | | | | | | | | | |
| Tone Control | Bass | 0 1 0 X X X X X | SB3 SB2 SB1 SB0 | | | | | | | | SB3 , ST3 : OOST / CUT | |
| | Treble | | ST3 ST2 ST1 ST0 | | | | | | | | | |
| Fader Control | Left Front | 0 1 1 X X X X X | | | | | | | | | | |
| | Left Rear | 1 0 0 X X X X X | | | | | | | | | | |
| | Right Front | 1 0 1 X X X X X | SF4 | SF3 | SF2 | SF1 | SF0 | X | X | X | | |
| | Right Rear | 1 1 0 X X X X X | | | | | | | | | | |
| Misc. Control | Rearin Con | 1 1 1 X X X X X | SRIC | | | | X | X | X | X | X | SET 'HIGH' |
| | MUTE | | SMUT E | | | | X | X | X | X | X | |
| | EXT.EQ | | SEQ | | | | X | X | X | X | X | |

cf> 'Rearin Control' of MISC.CONTROL is a **NOT-supported** function in present version of S1A0501X01.

So this bit should be always 'HIGH' when transferring control data.

SOFTWARE SPECIFICATION

— Input Select / Trimmer Setting / Loudness Control

| FUNCTION | SUBADDRESS | DATA BYTE | | | | | | | | | VALUE | REMARK |
|-----------------|------------|-------------|----|----|----|----|----|--------|----|--------|---------------------------------------|----------|
| Input Select | 0 0 0 | BYTE FORMAT | | | | | | | | | INPUT1 INPUT2 INPUT3 *INPUT4 | Not Used |
| | | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | | | |
| | | | | | 0 | 0 | X | X | X | | | |
| | | | | | 0 | 1 | X | X | X | | | |
| | | | | | 1 | 0 | X | X | X | | | |
| Trimmer Setting | | | | | 1 | 1 | X | X | X | | | |
| | | 0 | | | 0 | | X | X | X | 0 dB | 2 dB STEP (4) | |
| | | 0 | | | 1 | | X | X | X | - 2 dB | | |
| | | 1 | | | 0 | | X | X | X | - 4 dB | | |
| 1 | | | 1 | | X | X | X | - 6 dB | | | | |
| Loudness | | 0 | | | | | X | X | X | ON | | |
| | | 1 | | | | | X | X | X | OFF | | |

SOFTWARE SPECIFICATION - Volume Control

| FUNCTION | SUBADDRESS | DATA BYTE | | | | | | | | | VALUE | REMARK |
|----------------|-------------|-----------|----|----|----|----|----|----|----|--|---------------------|--------|
| Volume Control | BYTE FORMAT | | | | | | | | | 0 dB 0.6 dB 1.2 dB 1.8 dB 2.4 dB 3.0 dB 3.6 dB 4.2 dB 4.8 dB 5.4 dB 6.0 dB 6.6 dB 7.2 dB 7.8 dB 8.4 dB 9.0 dB | 0.6 dB STEP (16) | |
| | b7 b6 b5 | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | | | |
| | 0 0 1 | | | | 0 | 0 | 0 | 0 | X | | | |
| | | | | | 0 | 0 | 0 | 1 | X | | | |
| | | | | | 0 | 0 | 1 | 0 | X | | | |
| | | | | | 0 | 0 | 1 | 1 | X | | | |
| | | | | | 0 | 1 | 0 | 0 | X | | | |
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| | | | | | 0 | 1 | 1 | 0 | X | | | |
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SOFTWARE SPECIFICATION - Tone Control : Bass boost/cut1

| FUNCTION | SUBADDRESS | DATA BYTE | | | | | | | | VALUE | REMARK |
|--------------|------------|-------------|----|----|----|----|----|----|----|-------|-----------|
| Bass Control | 0 1 0 | BYTE FORMAT | | | | | | | | | 2 dB STEP |
| | | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | | |
| | | | | | | 0 | 0 | 0 | 0 | | |
| | | | | | | 0 | 0 | 0 | 1 | | |
| | | | | | | 0 | 0 | 1 | 0 | | |
| | | | | | | 0 | 0 | 1 | 1 | | |
| | | | | | | 0 | 1 | 0 | 0 | | |
| | | | | | | 0 | 1 | 0 | 1 | | |
| | | | | | | 0 | 1 | 1 | 0 | | |
| | | | | | | 0 | 1 | 1 | 1 | | |
| | | | | | | 1 | 1 | 1 | 1 | | |
| | | | | | | 1 | 1 | 1 | 0 | | |
| | | | | | | 1 | 1 | 0 | 1 | | |
| | | | | | | 1 | 1 | 0 | 0 | | |
| | | | | | | 1 | 0 | 1 | 1 | | |
| | | | | | | 1 | 0 | 1 | 0 | | |
| | | | | | | 1 | 0 | 0 | 1 | | |
| | | | | | | 1 | 0 | 0 | 0 | | |

SOFTWARE SPECIFICATION - Tone Control : Treble boost/cut

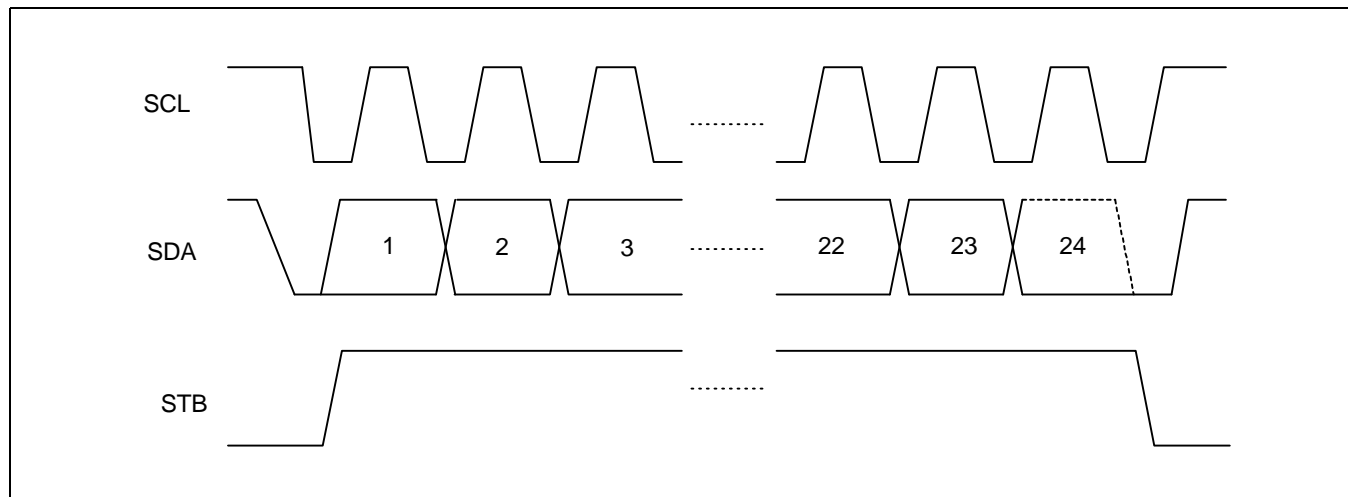
| FUNCTION | SUBADDRESS | DATA BYTE | | | | | | | | VALUE | REMARK |
|----------------|------------|-------------|----|----|----|----|----|----|----|-------|-------------|
| Treble Control | 0 1 0 | BYTE FORMAT | | | | | | | | | 1.7 dB STEP |
| | | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | | |
| | | 0 | 0 | 0 | 0 | | | | | | |
| | | 0 | 0 | 0 | 1 | | | | | | |
| | | 0 | 0 | 1 | 0 | | | | | | |
| | | 0 | 0 | 1 | 1 | | | | | | |
| | | 0 | 1 | 0 | 0 | | | | | | |
| | | 0 | 1 | 0 | 1 | | | | | | |
| | | 0 | 1 | 1 | 0 | | | | | | |
| | | 0 | 1 | 1 | 1 | | | | | | |
| | | 1 | 1 | 1 | 1 | | | | | | |
| | | 1 | 1 | 1 | 0 | | | | | | |
| | | 1 | 1 | 0 | 1 | | | | | | |
| | | 1 | 1 | 0 | 0 | | | | | | |
| | | 1 | 0 | 1 | 1 | | | | | | |
| | | 1 | 0 | 1 | 0 | | | | | | |
| | | 1 | 0 | 0 | 1 | | | | | | |
| | | 1 | 0 | 0 | 0 | | | | | | |

SOFTWARE SPECIFICATION - Fader / Miscellaneous Control DATA BYTE BYTE FORMAT

| FUNCTION | SUBADDRESS | DATA BYTE | | | | | | | | VALUE | REMARK |
|--------------------|--|-------------|----|----|----|----|----|----|----|--|---------------------|
| Fader Control | b7 b6 b5 0 1 1 1 0 0 1 0 1 1 1 0 | BYTE FORMAT | | | | | | | | Left Front Left Rear Right front Right Rear | |
| | | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |
| | | | | 0 | 0 | 0 | X | X | X | 0 dB | |
| | | | | 0 | 0 | 1 | X | X | X | - 1.25 dB | |
| | | | | 0 | 1 | 0 | X | X | X | - 2.5 dB | |
| | | | | 0 | 1 | 1 | X | X | X | - 3.75 dB | |
| | | | | 1 | 0 | 0 | X | X | X | - 5.0 dB | |
| | | | | 1 | 0 | 1 | X | X | X | - 6.25 dB | |
| | | | | 1 | 1 | 0 | X | X | X | - 7.5 dB | |
| | | | | 1 | 1 | 1 | X | X | X | - 8.75 dB | |
| | | 0 | 0 | | | | X | X | X | 0 dB | |
| | | 0 | 1 | | | | X | X | X | - 10 dB | |
| | | 1 | 0 | | | | X | X | X | - 20 dB | |
| | | 1 | 1 | | | | X | X | X | - 30 dB | |
| Rear-in Control | 1 1 1 | | | 0 | X | X | X | X | X | ENABLE | Should Be 'DISABLE' |
| | | | | 1 | X | X | X | X | X | DISABLE | |
| Mute | | | 0 | | X | X | X | X | X | ON | |
| | | | 1 | | X | X | X | X | X | OFF | |
| External Equalizer | | 0 | | | X | X | X | X | X | ENABLE | |
| | | 1 | | | X | X | X | X | X | DISABLE | |

SERIAL BUS INTERFACE PROTOCOL - THE GENERAL CASE

Timing Diagram of General MICOM Interface Bus Protocol

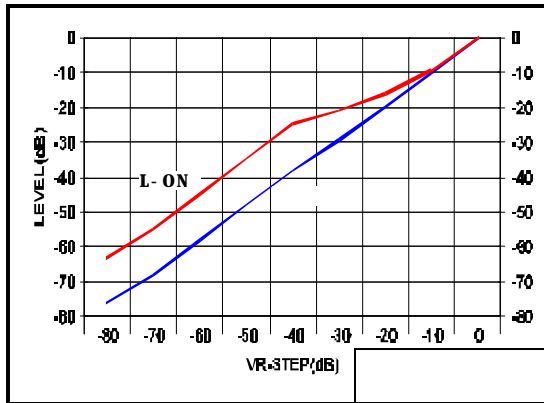
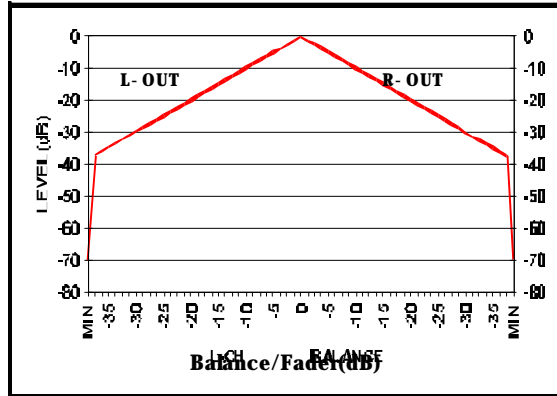
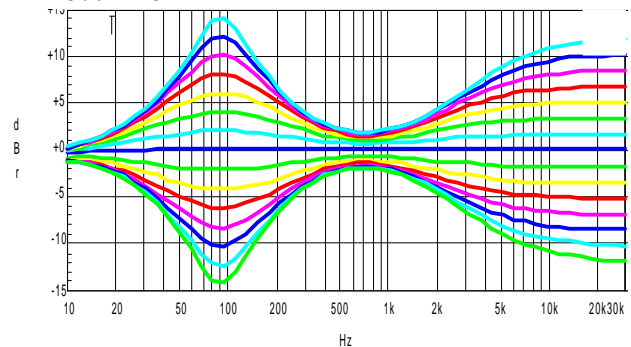
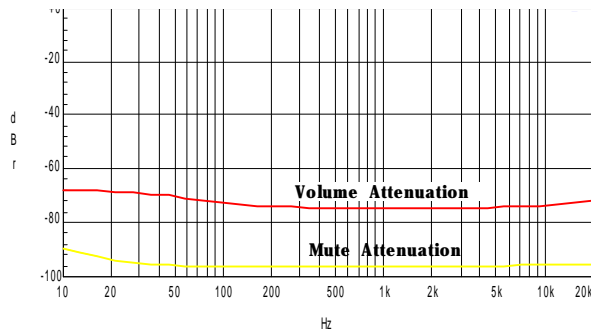
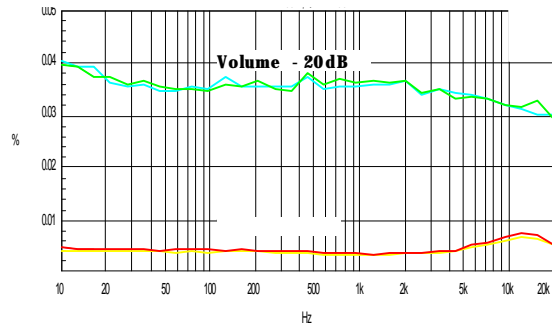
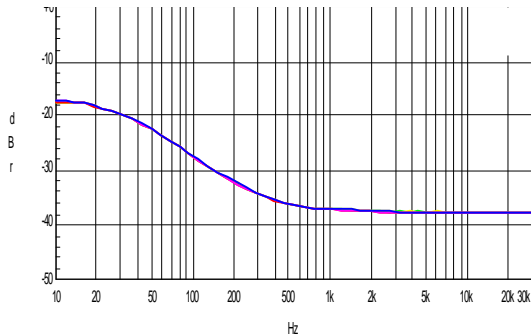


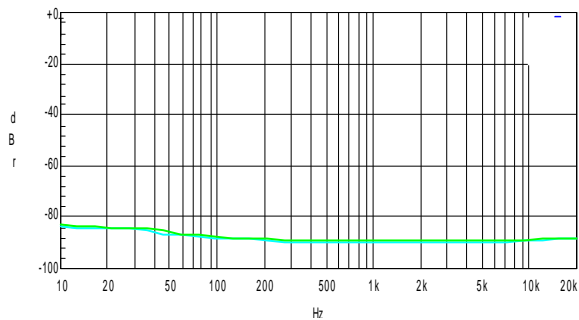
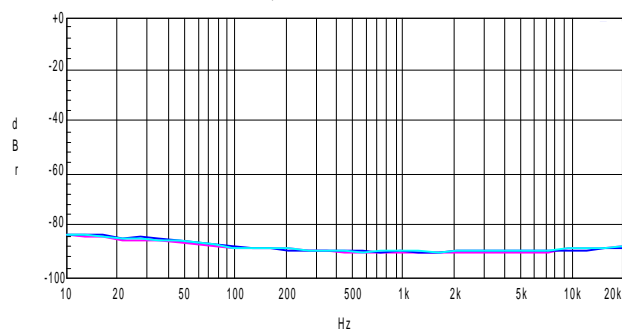
General MICOM Interface Bus Byte Format Of S1A0501X01

| Bit Stream | 1 - 7 | 8 | 9 - 16 | 17 - 24 |
|------------|------------------|---|---------------|---------|
| Meanings | Chip Select Code | | Function Code | DATA |

Chip Select Code = Same As I²C Bus Slave Address (1000000 × B)
 X = Don't Care Bit (Not Used Bit)
 Function Code = Transferred Data1 (assigning Function)
 DATA = Transferred Data2 (assigning Operation)
 STB Signal 'LOW' = Chip Not Selected.
 STB Signal 'HIGH' = Chip Selected.

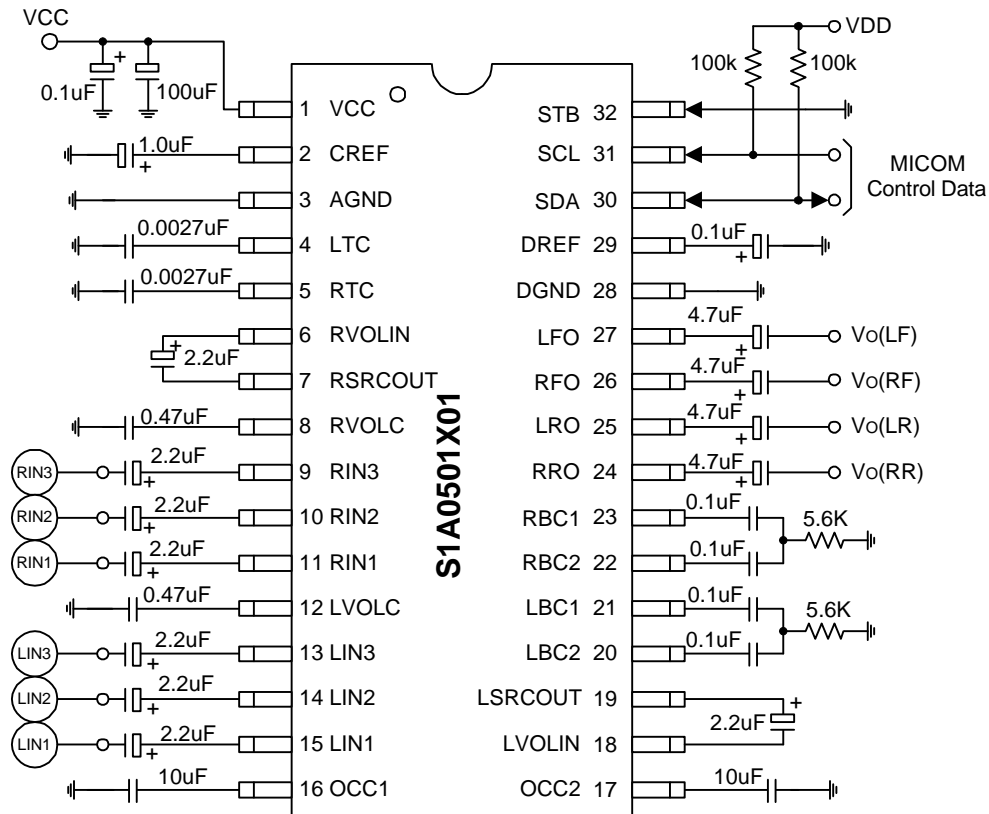
♣ Allowed Strobe Pulse Width (Maximum) ≤ 6.0ms

Volume Step vs output Level**Input :1Vrms****Vcc=12V****Balance & Fader Step vs output Level****Input :1Vrms****Vcc=12V****Bass & Treble Boost / Cut****Input : 300mVrms, Volume=Max****Vcc=12V****Loudness Boost****Input : 300mVrms, Volume=- 37.8dB****Vcc=12V**

Input CrossTalk**Selected Input : 1Vrms, Otherwise : Short****Vcc=12V****L/R Channel Separation****Selected Channel Input :1Vrms****The Other : Short, Vcc=12V**

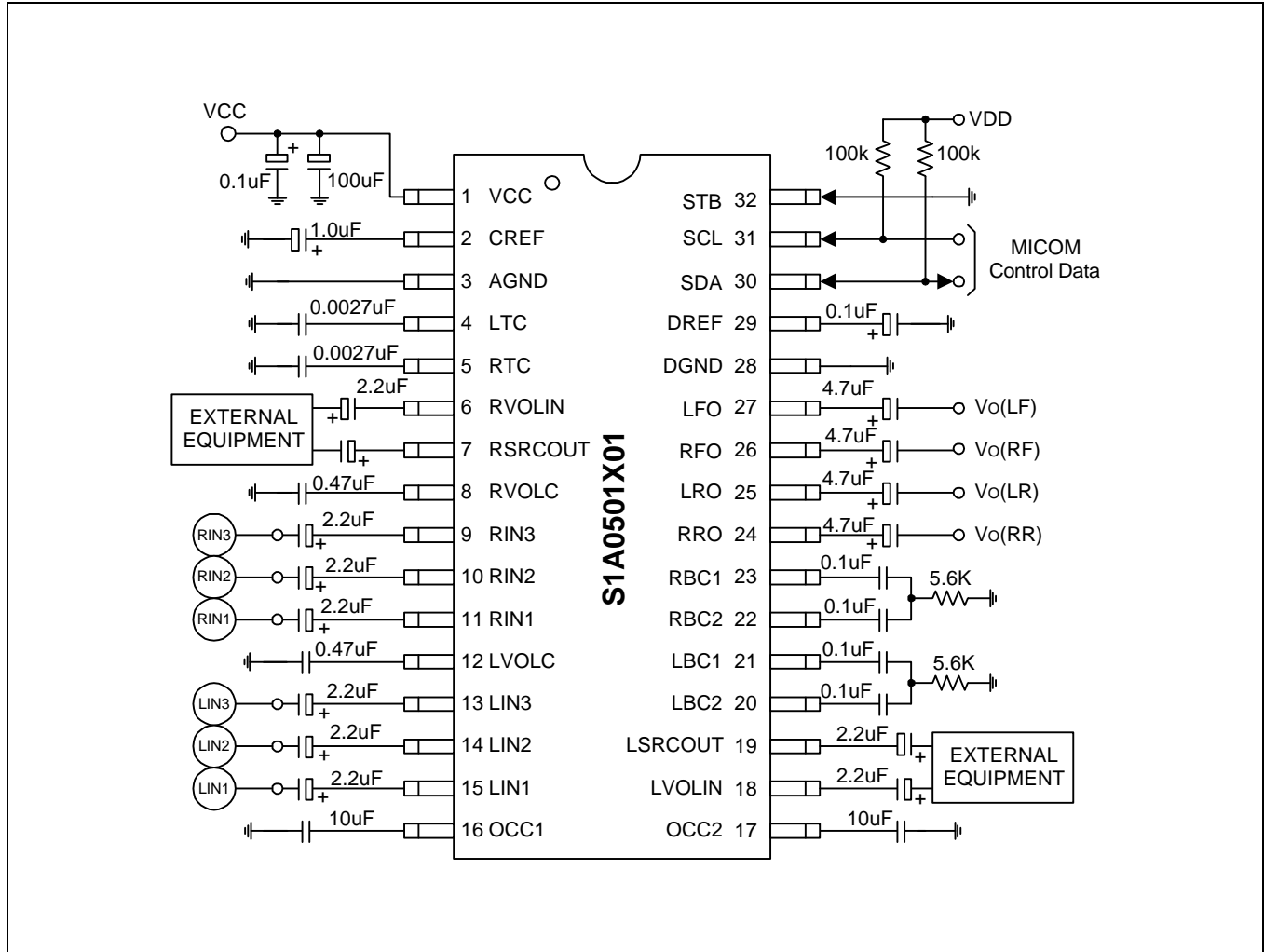
APPLICATION CIRCUIT 1

MODE I : 3 INPUTS - 1 OUTPUT



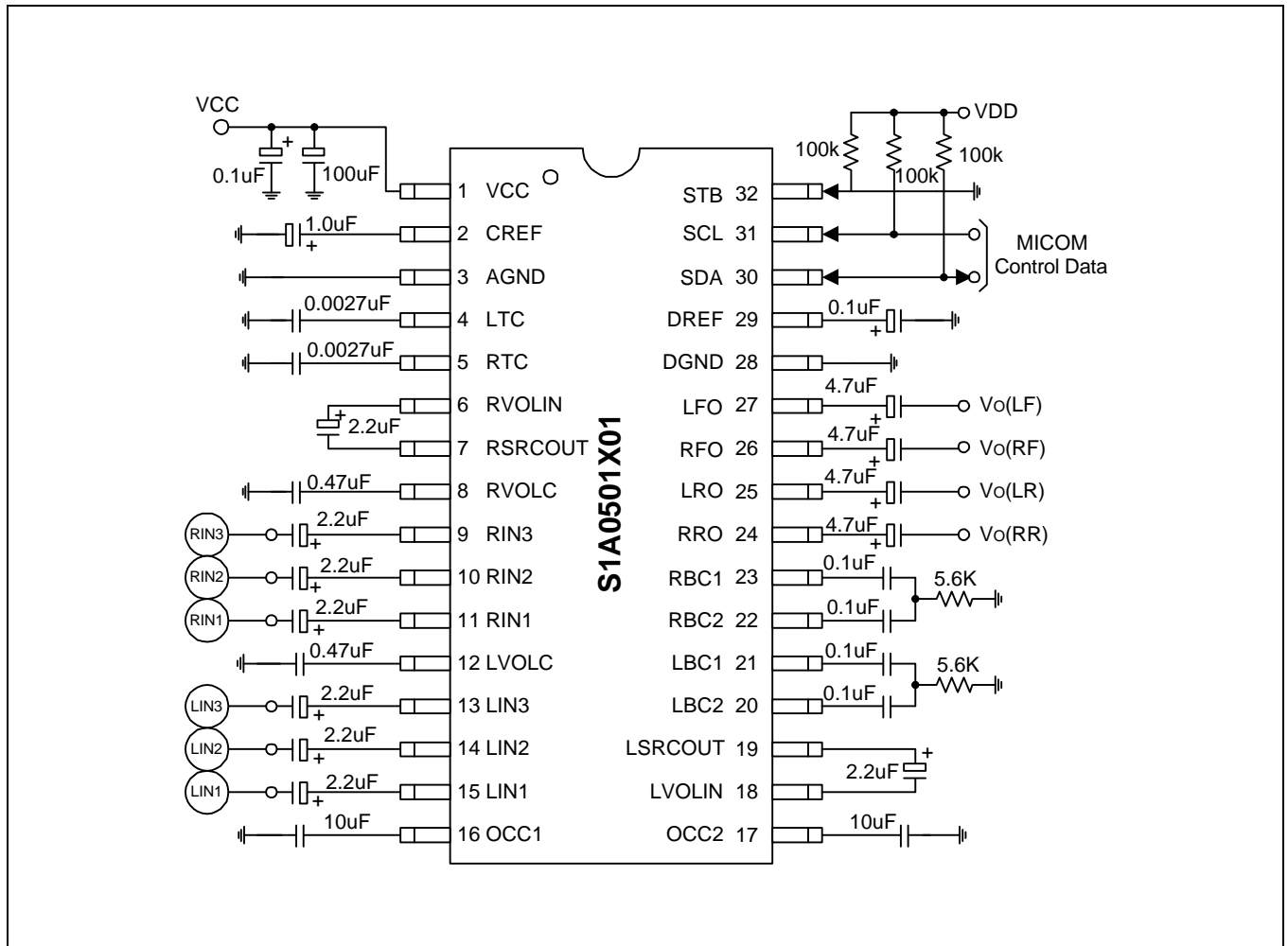
APPLICATION CIRCUIT 2

MODE II : 3 INPUTS - 1 OUTPUT W/ EXT.EQUIPMENT



Cf> Let the microprocessor set 'SEQ' signal to 0, if an external device is an audio-signal controlled processor such as a graphic equalizer.

APPLICATION CIRCUIT 3

MODE III : 3 INPUTS - 1 OUTPUT (NOT I²C BUS PROTOCOL)

NOTES