

**NEW TECHNICAL THEORY
FOR SERVICING**

MZ-R5ST OPERATION MANUAL



PORTABLE MINI DISC RECORDER

SONY®

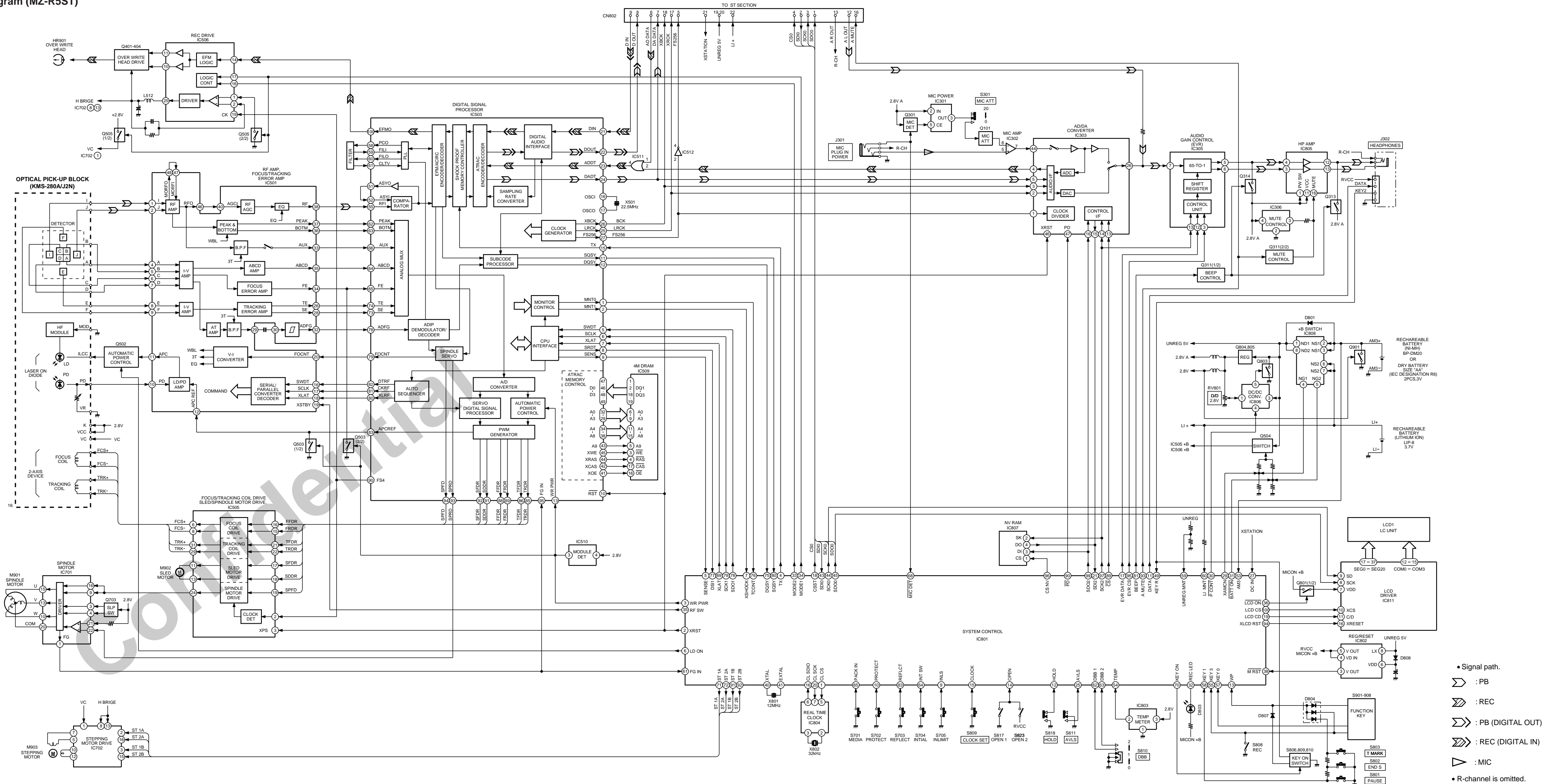
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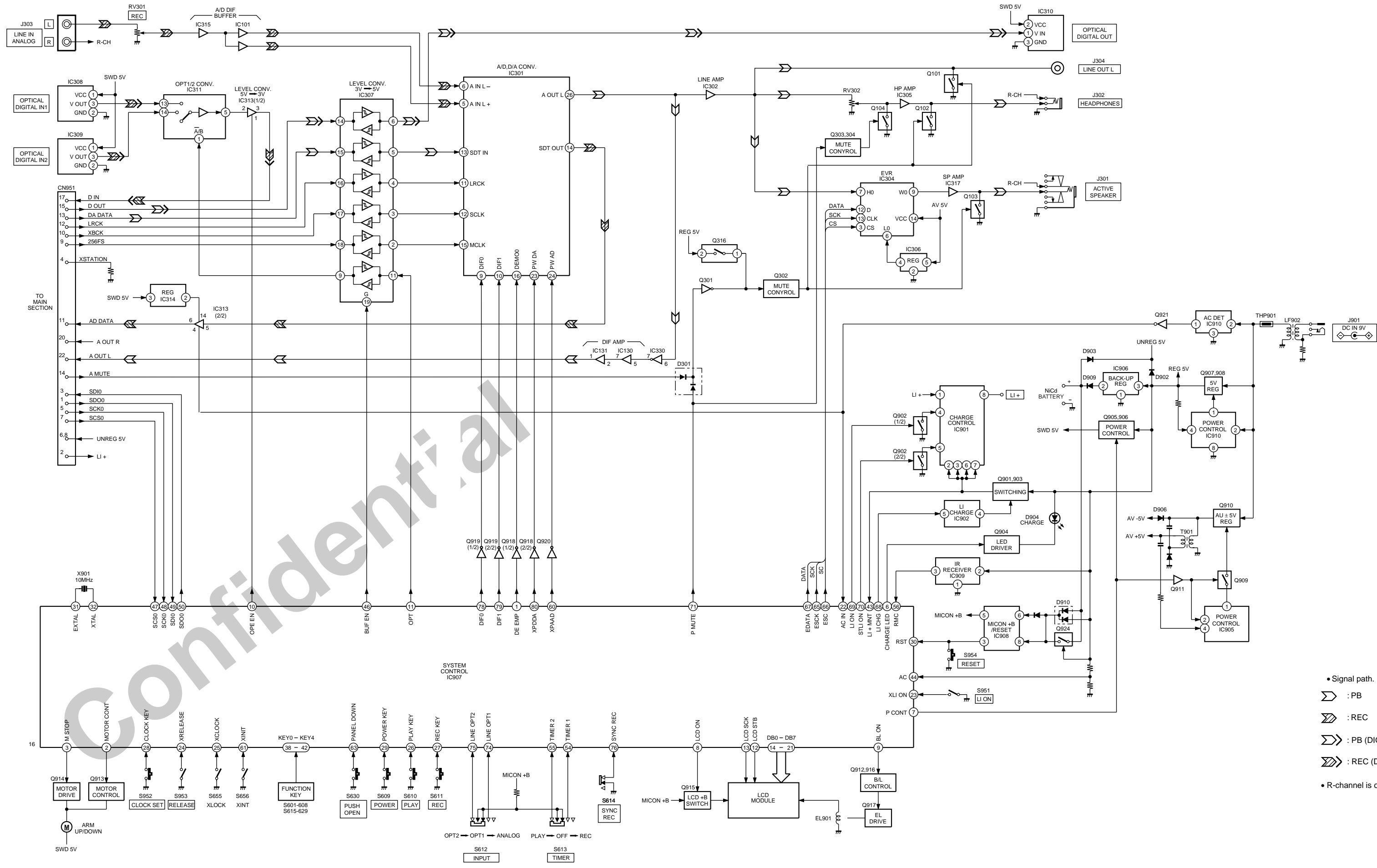
This NEW TECHNICAL THEORY FOR SERVICING describes theory of station (MZS-R5ST) and power supply circuit of MiniDisc recorder (MZ-R5ST).
Refer to MZ-R30 NEW TECHNICAL THEORY FOR SERVICING for theory of MiniDisc recorder.

1-1. Block Diagram (MZ-R5ST)

1. BLOCK DIAGRAMS



1-2. Block Diagram (MZS-R5ST)



2. FUNCTIONS AND FEATURES

MZ-R5ST is the new Sony portable MiniDisc Recorder of the fourth generation using the wide bit stream technology that is the first in the world as a portable MiniDisc Recorder. MZ-R5ST has the following functions and features.

- **Compact and slim recording/playback unit** : The MiniDisc Recorder is made small and compact as it has the limited functions of playback and recording (microphone recording only), and the editing function is handled by the station. Thus the size as thin as 20.1 mm and as light as 185 g (almost equal to the conventional portable MD player) is realized.
- **Built-in Sampling Rate Converter** : MZ-R5ST has the built-in sampling rate converter that enables recording from digital equipment using other sampling rates as DAT deck or a satellite tuner. (Sampling frequencies: 32 kHz, 44.1 kHz and 48 kHz are supported)
- **Wide Bit Stream Technology** : The input circuit, the output circuit and their peripheral circuits operate on the 20-bit audio data so that the maximum performance of the ATRAC IC which operates on 20-bit and higher can be fully utilized.
- **Synchronous Recording Function** : When dubbing digital signal from a source digital equipment such as CD player to MZ-R5ST using optical digital cable, operation is simple without the need to operate both the source side equipment and this unit.
- **Time Machine Recording Function** : Time Machine recording always stores the input sound into the DRAM IC in MZ-R5ST so that the sound that is two seconds ahead of pressing the record button can be recorded. This functions convenient not to miss recording of the very beginning of the program when recording off-the-air program of satellite broadcast or FM broadcast.
- **Built-in Rehearsal Function** : Editing points can be checked in units of 0.06 seconds in the range of 256 steps (total 8 seconds) from -128 step to +127 step centering around the editing point. This function is convenient in the editing such as Divide editing.
- **Built-in UNDO Function** : UNDO function lets operator undo an editing operation when operator makes an operational error.,
- **Output Jack For Active Speakers** : The STEREO-MINI output terminal for active speakers is equipped. Sound volume of the active speakers can be controlled by key operation of station or key operation of remote controller.

Differences of functions between the 4th generation MiniDisc recorder (MZ-R30) and MZ-R5ST are shown below.

Table 2-1 Comparison of functions between the 4th generation MiniDisc recorder (MZ-R30) and MZ-R5ST

Functions of MiniDisc recorder	MZ-R5ST	MZ-R30
Headphones output	○	○
LINE output	MiniDisc recorder : ✕ Station side : ○	○
Digital output	MiniDisc recorder : ✕ Station side : ◎	✕
Active speaker output	◎	✕
LINE input	MiniDisc recorder : ✕ Station side : ○	○
Digital input	MiniDisc recorder : ✕ Station side : ◎ (2 inputs)	○ (1 input)
Microphone input	MiniDisc recorder : ○ (External stereo) Station side : ✕	○ (External stereo)
AVLS	○	○
DBB (Digital Bass Boost)	○	○
RESUME	○ (Always ON)	○ (Always ON)
BEEP	○	○
Monaural recording	○	○
Monaural playback	○	○
Automatic track mark	○	○
Character input	○	○
Sampling rate converter	MiniDisc recorder : ○ Station side : ✕	○
20-bit wide bit stream	◎	✕
Synchro-recording	◎	○
Time Machine recording	◎	✕
Timer standby function	◎	✕
Program playback	◎	✕
Rehearsal function	◎	✕
Undo function	◎	✕

Note : The mark ◎ in the table indicates the new functions.

3. CIRCUIT THEORY OF MZ-R5ST STATION

3-1. System Configuration

(1) System Configuration of MiniDisc Recorder (MZ-R5ST).

Fig. 3-1 shows system configuration (MZ-R5ST). MiniDisc recorder (MZ-R5ST) is described briefly as follows.

First, the flow of signals during recording is described. The MIC IN signal that is passed through the microphone amplifier IC302 inputs the AD/DA converter IC303 where the microphone signal is converted to the 16-bit digital data by a built-in A/D converter. The digital signal is sent to the DSP IC503 via the OR gate IC511. During LINE recording, the 20-bit digital data that is A/D converted by the station (MZS-R5ST) (refer to the next section of this manual (2) System Configuration of Station (MZS-R5ST) for more details), is input to the DSP IC503 via the OR gate IC511. The other input that is the DIGITAL IN input signal, is input directly to the DSP IC503. At IC503, signal processing (compression, interleaving, EFM modulation, etc.) is performed on the input digital data to generate the EFM signal. The EFM signal thus generated is recorded on the MO disc via the REC DRIVE IC506.

Next, the flow of signals during playback is described. The EFM signal that is read by the optical pickup is input to the DSP IC503 via the RF amplifier IC501. At IC503, signal processing (EFM demodulation, de-interleaving, expansion, etc.) is performed on the input EFM signal to generate the DA data. When the MiniDisc recorder (MZ-R5ST) is used as a stand-alone unit, the DA data is sent to the AD/DA converter IC303 where the DA data is passed through the internal DBB (Digital Bass Boost) circuit, digital filter and is converted to the L-channel and R-channel analog signal by D/A converter. The D/A converted L-channel and R-channel analog signal passes through the audio gain control IC305, headphones amplifier IC805 and then to HEADPHONES. When station unit is connected, the DA data is output to the AD/DA converter IC301 of the station connected.

Next, the flow of the servo signals is described below. The error signals that are read by optical pickup are sent to the DSP IC503 after passing the various error amplifiers inside the RF amplifier IC501. In the DSP IC503, the input error signals are performed the servo calculations by the internal digital servo processor to generate the servo signal. The servo signals are then output and used to drive coils and motors via the coil/motor drive IC505.

The system controller IC801 is described lastly. The system controller IC801 controls the whole system of the MZ-R5ST. The main control functions of the respective ICs and the input signals that are controlled by the system controller IC 801 are shown below.

- ◆ Controls the DSP IC503 :
 - Control of the respective servo processings.
 - Selection of mode (recording or playback) of the respective signal processing blocks
 - Control of input sound source (AD data or digital data), etc.
- ◆ Controls the RF amplifier : Selection of mode (PIT or GROOVE) of the RF amplifier, etc.
- ◆ Controls the audio gain control IC305 : Control of the output volume
- ◆ Controls the AD/DA converter IC303 : Control of the DBB circuit, etc.
- ◆ Controls the NV RAM IC807: Control of the E-F balance values during servo processing
- ◆ Controls the stepping motor drive IC702
- ◆ Controls the REC DRIVE IC506
- ◆ Communication with the system controller IC907 of station unit
- ◆ Controls the input signals from keys and switches
- ◆ Controls temperature inside the MiniDisc recorder
- ◆ Controls the clock information
- ◆ Drives LCD

(2) System Configuration of Station (MZS-R5ST).

Fig. 3-2 shows system configuration (MZS-R5ST). Station (MZS-R5ST) is described briefly as follows.

First, the flow of signals during recording is described. When station (MZS-R5ST) is in the LINE recording mode, the L-channel and R-channel analog signals that are input from the LINE IN JACK J303 are sent to the AD/DA converter IC301 via the LINE amplifier IC315, the differential buffers IC101 and IC201. The LINE input signal is converted to the 20-bit digital data by the A/D converter inside IC301. The 20-bit digital data is output to MiniDisc recorder (MZ-R5ST). The digital recording mode is described next. The station (MZS-R5ST) has the two channel digital inputs. The digital signal that is input from the DIGITAL IN is sent to the DIN selector IC311. The station (MZS-R5ST) has the recording source selector switch. When operator operates the recording source selector switch, result of selection is input to the system controller IC907 so that IC907 recognizes the selected recording source and controls the selector switch inside the DIN selector IC311. Thus the digital data that is going to be output to MiniDisc recorder (MZ-R5ST), is determined. The digital data that is selected by the DIN selector IC311 is output to MiniDisc recorder (MZ-R5ST) via the level converter IC313.

Next, the flow of signals during playback is described. The DA data that is output from the DSP IC503 of MiniDisc recorder (MZ-R5ST), is input to the AD/DA converter IC301 where the DA data is passed through the digital filter and is converted to the L-channel and R-channel analog signals by D/A converter. The D/A converted L-channel and R-channel analog signals are output to the LINE OUT jack J304 via the LINE amplifier IC302, output to the HEADPHONES OUT jack J302 via the LINE OUT amplifier IC302, PB VOLUME RV302 and headphones amplifier IC305. The D/A converted L-channel and R-channel analog signals are also output to the ACTIVE SPEAKER OUT jack J301 via the LINE OUT amplifier IC302 and buffer IC317, and is at the same time output to the AUDIO GAIN control IC305 of MiniDisc recorder (MZ-R5ST) via a differential amplifier.

The system controller IC907 is described lastly. The system controller IC907 controls the whole system of MZS-R5ST. The main control functions of the respective ICs and the input signals that are controlled by the system controller IC907 are shown below.

- ◆ Controls the DIN selector IC311 : Control of the digital data (DIN1 or DIN2) that is going to be output to MiniDisc recorder (MZ-R5ST)
- ◆ Controls the level converter : Selection of POWER ON/OFF
- ◆ Controls the EVR IC304 : Control of the output volume for active speakers
- ◆ Controls the AD/DA converter IC301 : Control of ON/OFF of the A/D converter and D/A converter, etc.
- ◆ Communication with the system controller IC801 of MiniDisc recorder (MZ-R5ST)
- ◆ Controls the input signals from keys and switches
- ◆ Drives LCD

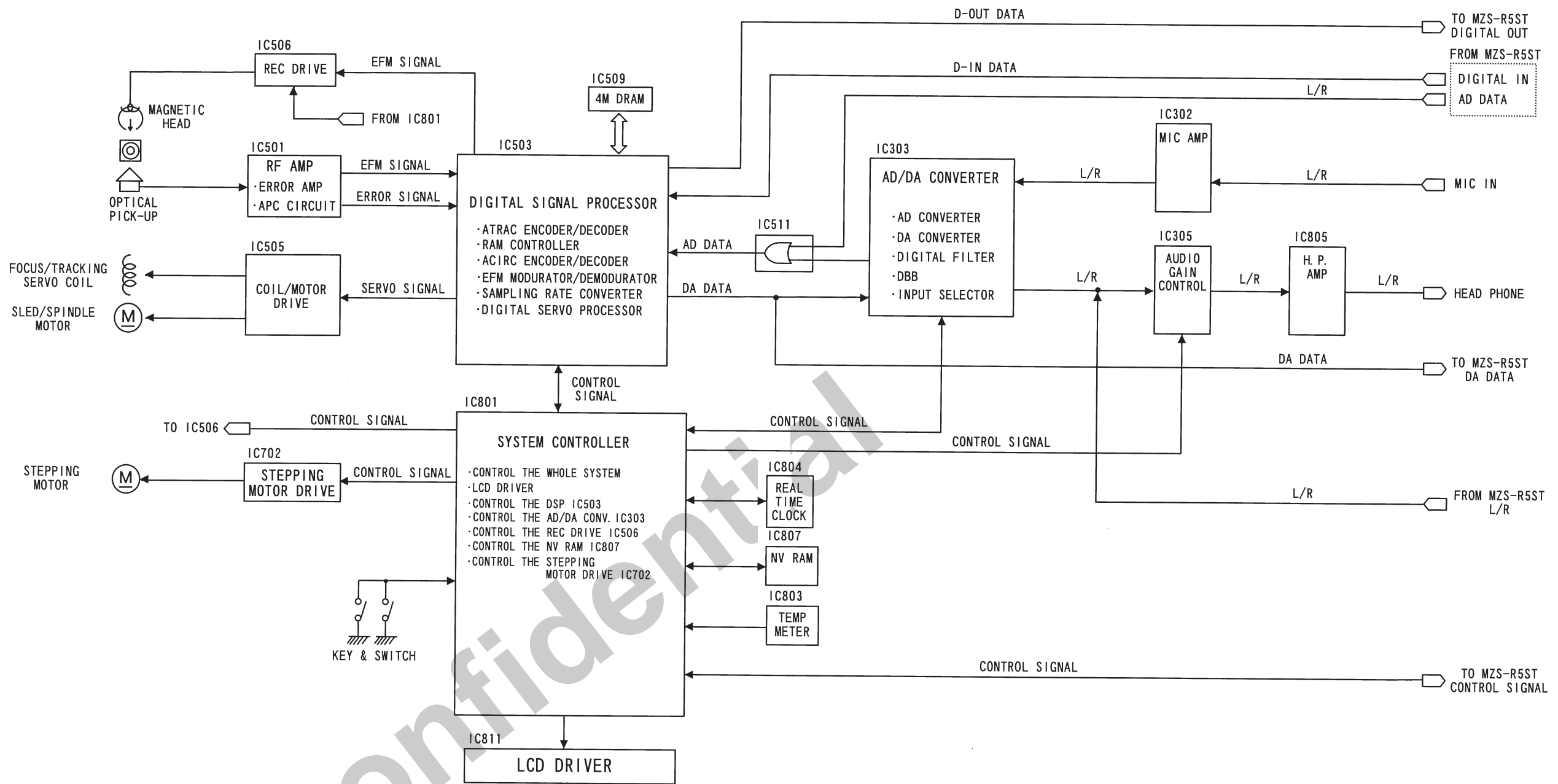


Fig. 3-1 System configuration (MZ-R5ST)

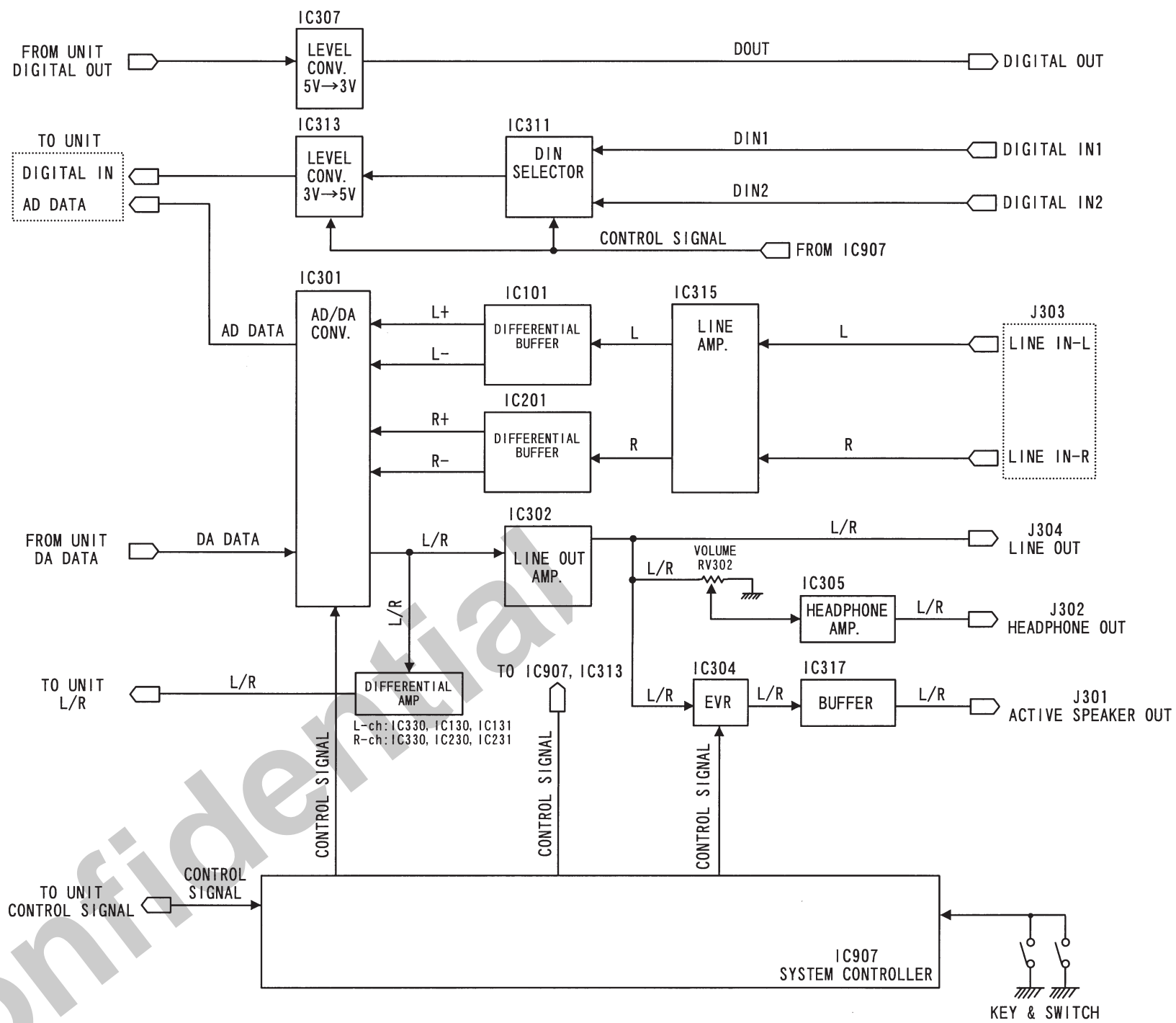


Fig. 3-2 System configuration (MZS-R5ST)

3-2. Microprocessor Interface

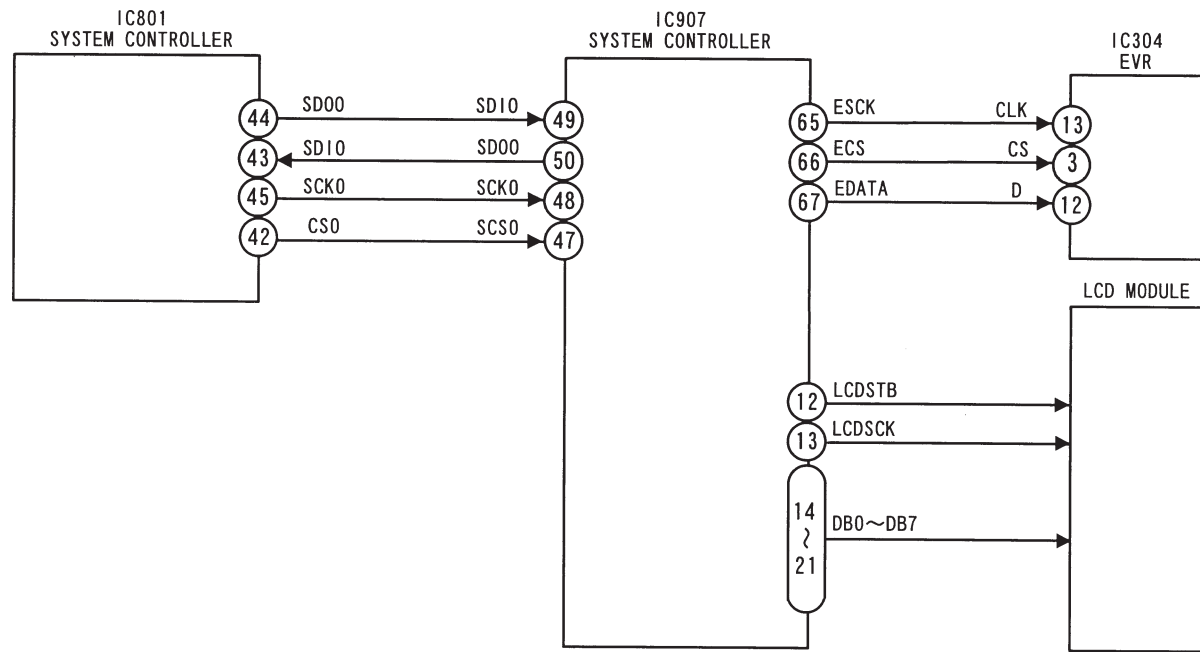


Fig. 3-3 Microprocessor interface

Fig. 3-3 shows microprocessor interface between station unit and MiniDisc recorder.

1. Communication between system controller IC801 and IC907

The system controller IC801 of MiniDisc recorder sends the various commands in the form of serial data to the system controller IC907 of station in order to establish communication between them. These serial data are output from IC801 pin④④ [SD00] to the system controller IC907 of station, in synchronization with clock signal that is output from pin④⑤ [SCK0] and chip select signal from pin④② [CS0]. The system controller IC907 of station reads the serial data and executes the operations in accordance with the input serial data. When the data-read command is issued, the data that corresponds to the command, is output from pin⑥⑤ [SD00] in synchronization with the clock that is input to pin④⑧ [SCK0].

The main interfaces are shown below.

- ◆ From system controller IC907 (station) → System controller IC801 (MiniDisc recorder)
 - Input data from operation keys
 - Selection of recording mode (Stereo/Monaural, Digital/Analog), etc.
- ◆ From system controller IC801 (MiniDisc recorder) → System controller IC907 (station)
 - Presence or absence of rechargeable lithium-ion battery
 - LCD display data
 - Time information
 - Disc information (Presence or absence of disc, CD or MO, copy protection) etc.

2. Communication between system controller IC907 and EVR IC304

When the system controller IC907 detects that the active speaker VOLUME key is pressed at pin④④ [KEY3] or pin⑥⑥ [RMC] input, IC907 outputs data from pin⑥⑦ [EDATA] to EVR IC304 in synchronization with the clock at pin⑥⑤ [ESCK] and the chip select signal at pin⑥⑥ [ECS]. Output data from IC907 controls the output signal from ACTIVE SPEAKER OUT J301.

3. Communication between system controller IC907 and LCD block

The system controller IC907 controls the display data by transferring data to the LCD module through the 8 parallel data. The display data is output from the eight data output pins of pin①④ [DB0] through pin②① [DB7], to the LCD module in synchronization with clock at pin①③ [LCD SCK] and the strobe signal at pin①② [LCD STB].

3-3. Power Supply Circuit

Fig. 3-4 shows a block diagram of the power supply circuit (MZS-R5ST).

(1) Generating the UNREG power supply voltage

When the DC plug is inserted to the DC jack, 9 V is input to POWER CONTROL1 IC904 pin② [VCC] via a line filter LF902, which starts up IC904. As IC904 starts up, the PWM waveform that is generated by the internal PWM comparator, is output from pin① [OUT]. Q908 and Q907 start switching operation as a result of this PWM waveform output, and the step-down DC-DC converter circuit is started up. After the Q907 output is smoothed by D905, L903 and C908, the voltage resistance-divided by R915 to R917 is fed back to pin④ [INPUT] of IC904. Based on this feedback voltage, IC904 controls the voltage by controlling the PWM wave duty generated by the PWM comparator inside. As a result of this operation, the UNREG 5 V is generated. (Refer to Fig. 3-7 and Fig. 3-8.)

(2) Generating the 2.9 V for system controller IC801

The UNREG voltage that is generated by the UNREG power generating circuit, is input to the RESET IC908 pin⑥ [VDD]. When IC908 starts up, 2.9V is generated by the internal step-up/step-down regulator. And 2.9V is output from pin⑤. The output 2.9 V is input to the system controller IC907 pin② [VDD] to start up the system controller IC907.

(3) Generating the SWD 5 V

When system controller IC907 starts up, IC907 detects whether MiniDisc recorder (MZ-R5ST) is connected to station or not, from state of pin⑮ [XLOCK] (“L”: when MiniDisc recorder is connected). When MiniDisc recorder is connected to station, and when the POWER key S609 is pressed to set the pin⑲ [POWERKEY] input to “L”, the system controller IC907 outputs “H” from pin⑦ [PCONT]. Q906 and Q905 are turned “ON” by this “H” signal so that the UNREG voltage is supplied as the SWD 5 V to the respective ICs such as DIN SELECTOR IC311 and others. When MiniDisc recorder has not been connected to station and is connected later, output from IC907 pin⑦ [PCONT] goes to “H” immediately.

Fig. 3-5 shows the timing chart when the POWER key is pressed with MiniDisc recorder connected to station.

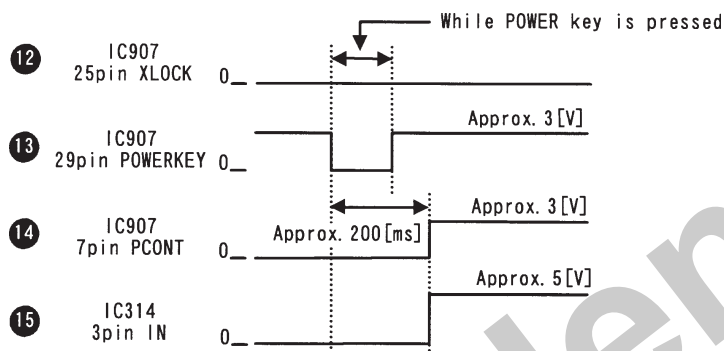


Fig. 3-5 Timing chart when the POWER key S609 is pressed

(4) Generating the 2.9 V for the level converter IC313

The SWD 5 V is supplied to the 2.9 V REG IC314 pin③ [IN] to start up IC314. As IC314 is started up, the 2.9 V is generated by internal series regulator and is output from pin② [OUT]. The 2.9 V is output to the level converter IC313 as its startup voltage.

(5) Generating the AUDIO ± 5 V

Fig. 3-6 shows the waveform timing chart when generating the AUDIO ± 5 V. When the system controller IC907 is started with MiniDisc recorder connected to station, "H" signal is output from pin⑦ [PCONT]. Q911 (1/2) and (2/2) are turned "ON" by this "H" signal so that the 9 V that is input to the DC jack, is supplied to the POWER CONTROL2 IC905 pin② [VCC] through the line filter LF902 and L904. When IC905 starts up, the PWM waveform that is internally generated by the built-in PWM comparator, is output from pin① [OUT]. Q910 is started the switching operation by this PWM waveform, and the step-down DC-DC converter circuit is started up. Then output of Q910 (refer to ⑥ of Fig. 3-6) is input to T901 where its energy is converted (refer to ⑦ of Fig. 3-6), smoothed by T901 coil and C911 to generate +5 V (refer to ⑧ of Fig. 3-6). The +5 V is voltage-divided by the voltage-divider-resistor of R918 to R920, R955 and R922. Output voltage from the divider is fed back to IC905 pin④ [INPUT]. Based on this feedback voltage, IC905 controls the voltage by controlling the PWM waveform duty generated by the internal PWM comparator. The AUDIO +5 V is thus generated. The AUDIO +5 V is supplied to the AUDIO circuit via smoothing circuit of L902 and C906. (Refer to Fig. 3-9.)

Output of Q910 (refer to ⑥ of Fig. 3-6) is smoothed out by D906 and a negative voltage power is generated. (Refer to ⑩ of Fig. 3-6.) The negative voltage power is removed of ripple by L901, C905 and C909, and the AUDIO -5 V (Refer to ⑪ of Fig. 3-6.) is generated. (Refer to Fig. 3-9.)

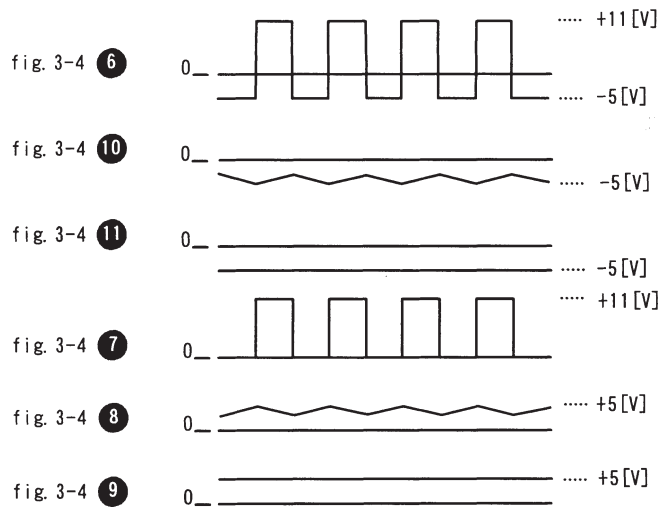


Fig. 3-6 Waveform timing when generating the AUDIO ± 5 V

(6) Generating 2.5 V to be used inside EVR IC304

When the AUDIO +5 V is input to pin⑥ [IN] of the 2.5 V REG. IC306. The 2.5V is generated by the internal series regulator. The 2.5 V is output from pin④ [OUT] and used as the internal power supply voltage of EVR IC304.

(7) Operation of voltage detector IC910

Whether AC power is input to station or not, is detected at pin② [ACIN] of the system controller IC907. ("L": when AC power is connected.) The voltage detector IC910 is installed in order to change the port input of pin② [ACIN] earlier, when AC power cord is removed from station. When input to IC910 pin② becomes lower than 4.5 V, FET inside IC910 is turned on so that "L" is output from pin①. Q921 is turned off by this "L" signal. And "H" is input to pin② [ACIN] of system controller IC907.

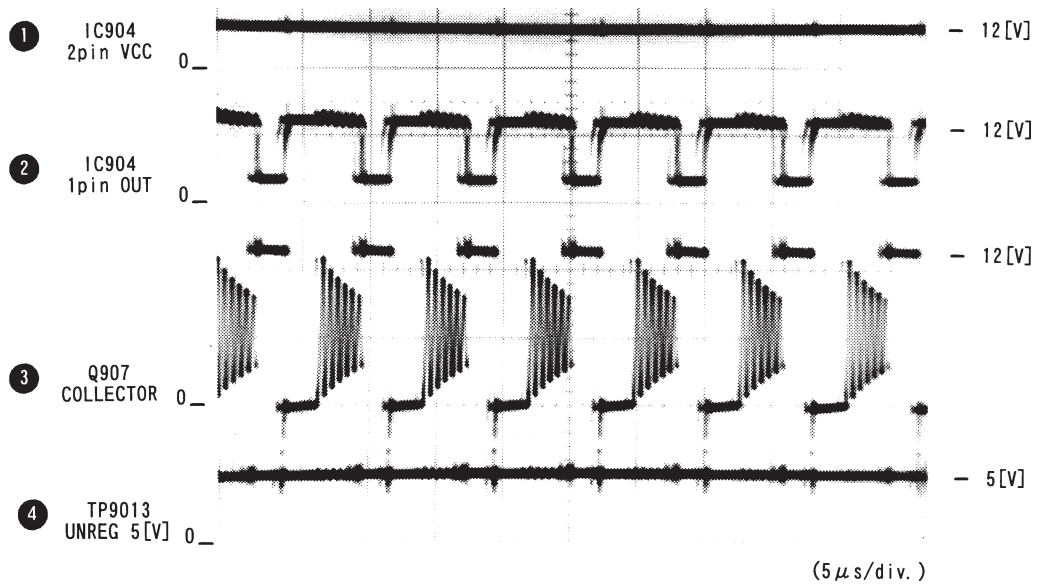


Fig. 3-7 UNREG power supply voltage generator circuit waveform timing chart (when MiniDisc recorder is not connected to station)

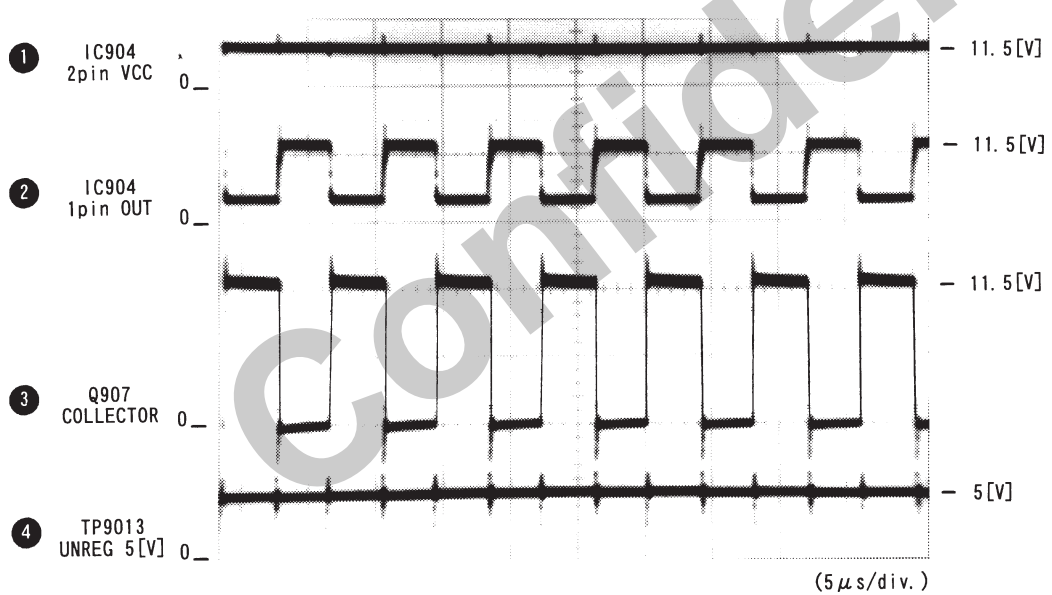


Fig. 3-8 UNREG power supply voltage generator circuit waveform timing chart (when MiniDisc recorder is connected to station)

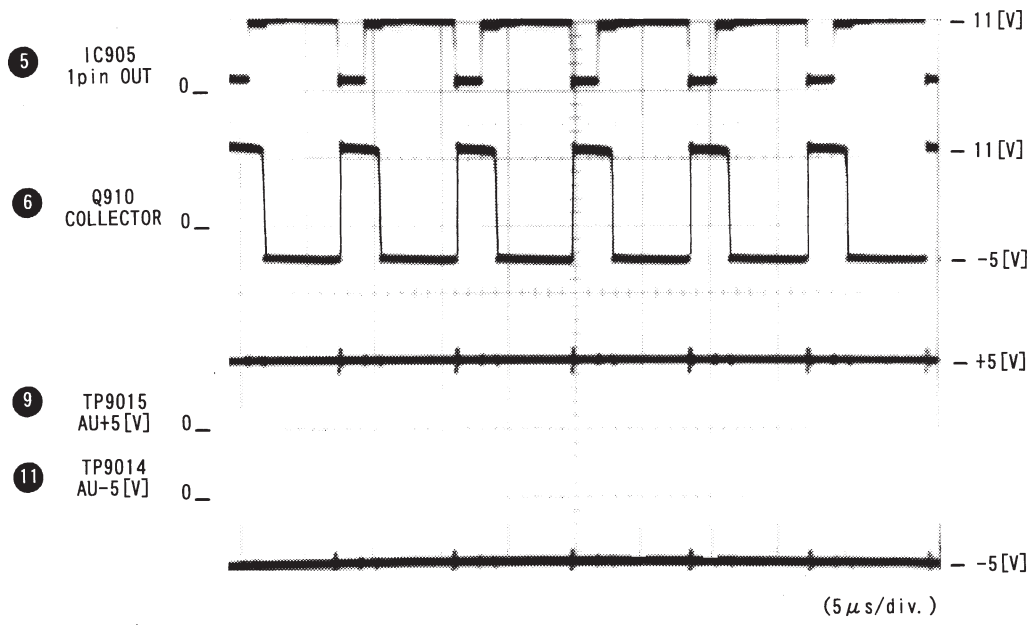


Fig. 3-9 AUDIO ± 5 V power supply voltage generator circuit waveform timing chart

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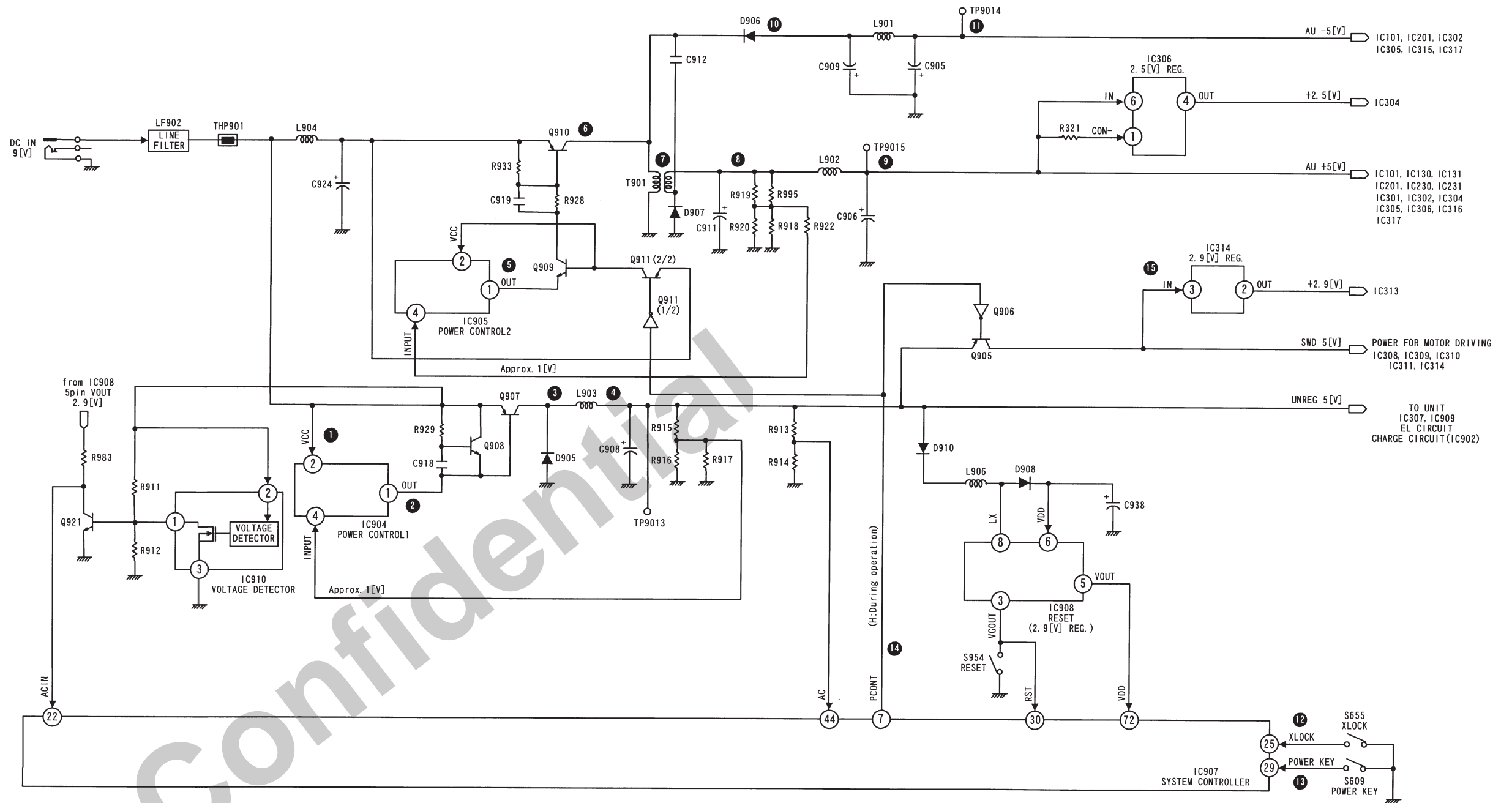


Fig. 3-4 Block diagram of the power supply circuit(MZS-R5ST)

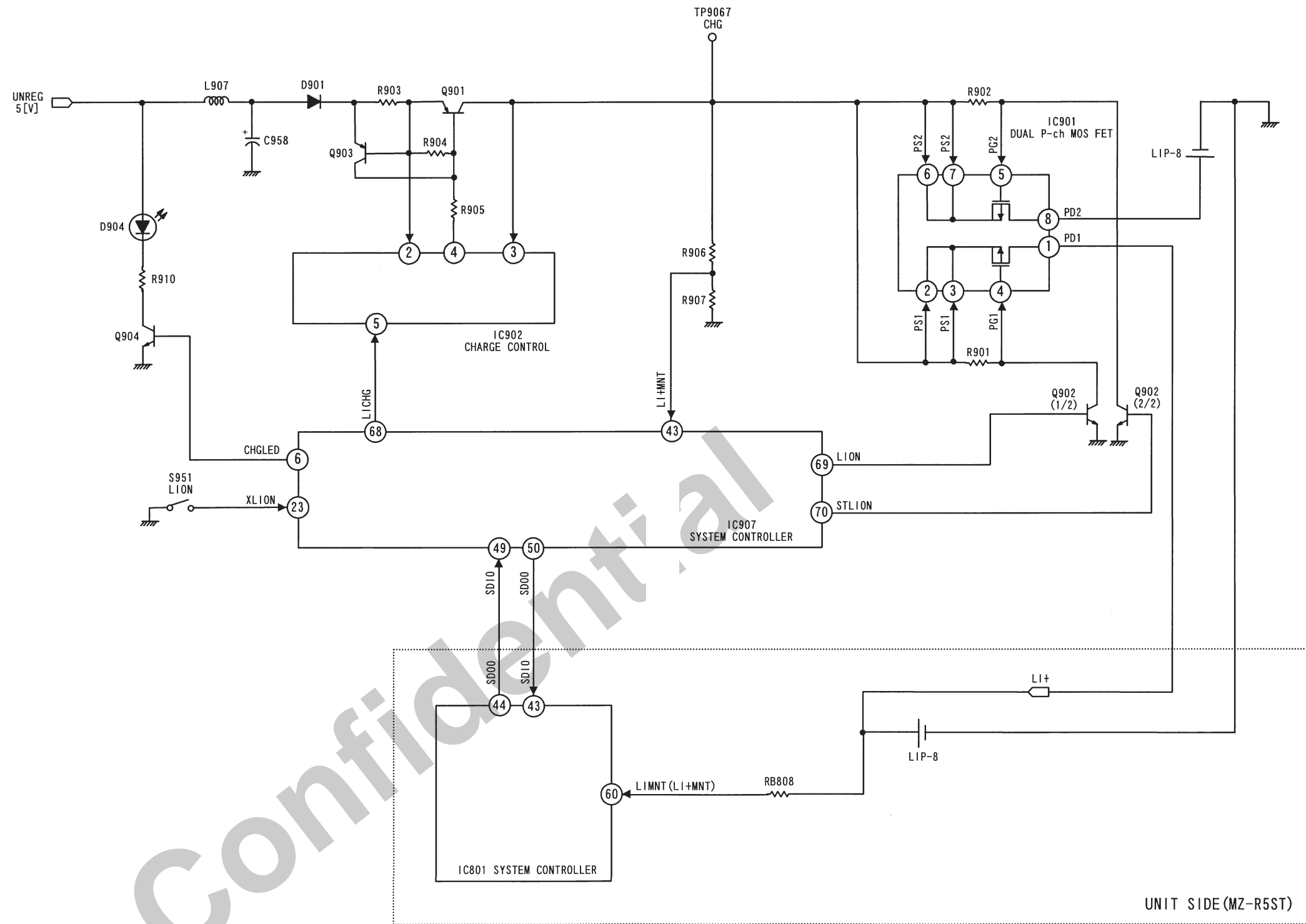


Fig. 3-10 Charging circuit

3-4. Charging Circuit

Fig. 3-10 shows the charging circuit. Charging operation starts when the following conditions are satisfied.

- ◆ When MiniDisc recorder is not connected to station : The main power is supplied to station and lithium-ion battery is connected.
- ◆ When MiniDisc recorder is connected to station : The main power is supplied to station and lithium-ion battery is connected either to MiniDisc recorder to station.

The charging operation when MiniDisc recorder is connected to station, is described first. When the main power is supplied to the station that is connected to the MiniDisc recorder, the respective system controller ICs of MiniDisc recorder and of station are activated. Then the system controller ICs of MiniDisc recorder and of station check presence and absence of rechargeable lithium-ion battery as shown in Table 3-1. Result of this check is sent from the system controller IC801 of MiniDisc recorder to that IC907 of station with the serial command. (This communication can be checked using the service mode installed this unit. Refer to service manual for more details.)

Table 3-1 Presence or absence of lithium-ion battery

	IC801 pin⑥ [LIMNT (LI+MNT)]	IC907 pin② [XLION]
MiniDisc recorder	H	–
Station side	–	L

When the system controller IC907 detects that a lithium-ion battery is connected to either station or MiniDisc recorder, IC907 sets either pin⑥ [LION] or pin⑦ [STLION] whichever a battery is connected, to “H”. The P-channel MOS FET inside IC901 is turned “ON” by this “H” signal. Next, the system controller IC907 outputs “L” from its pin⑧ [LICHG]. CHANGE CONTROL IC902 is started up by this “L” signal. When IC902 is started up, IC902 outputs “L” (approximately 3.6 V) from pin④. Q903 and Q901 are turned “ON” by this “L” signal to start charging operation with constant current and constant voltage. The “LI+ voltage” that is output from Q901, is input to the dual P-channel MOS FET IC901 to supply the “LI+ voltage” (approximately 4.2 V) to the respective rechargeable lithium-ion batteries via P-channel MOS FET inside IC901.

Table 3-2 Supply of the “LI+ voltage”

Presence or absence of rechargeable lithium-ion battery	IC907 pin⑥ [LION]	IC907 pin⑦ [STLION]
MiniDisc recorder (MZ-R5ST) : Presence	H	–
MiniDisc recorder (MZ-R5ST) : Absence	L	–
Station side (MZS-R5ST) : Presence	–	H
Station side (MZS-R5ST) : Absence	–	L

IC902 detects the charging voltage (4.2 V) at its pin③. IC902 controls the output voltage from its pin④ using this feedback voltage.

The system controller IC907 outputs “H” from pin⑥ [CHGLED] while charging the rechargeable lithium-ion battery connected to station. D904 is illuminated by this “H” signal.

3-5. System Backup Circuit

Fig. 3-11 shows the system backup circuit. Station (MZ-R5ST) adapted the built-in rechargeable Ni-Cd battery as shown in Fig. 3-11.

1. Charging circuit

When DC plug is connected to DC jack, the UNREG +5 V is generated and is sent to the 3.3 V regulator IC906 pin③ [IN]. When the 3.3 V regulator IC906 is started up, 3.3 V is generated by the series regulator inside IC906 and is output from pin② [OUT]. The 3.3 V is supplied to rechargeable Ni-Cd battery as the charging voltage. It takes about 10 hours to fully charge a battery. This battery operates about one week as the power supply for TOC writing during timer recording even though AC power is kept disconnected.

2. Operation when system backup works

When DC plug is disconnected from DC jack, the P-channel MOS FET Q924 is turned on, and the output voltage from the rechargeable backup battery is supplied to the RESET IC908 pin⑥ [VDD] via Q924. The RESET IC908 has the VDD power supply voltage detection circuit, and the IC908 controls the self-step-up circuit consisting of L906, D908, C938 and the switching output of pin⑧ [LX] to maintain the VDD input voltage always above 3.4 [V]. When IC908 is started up, the MICON +B voltage 2.9 V is generated by the step-up/step-down regulator inside IC908. IC908 then outputs the generated 2.9 V from pin⑤ [VOUT] to the system controller IC907 pin⑦ [VDD].

When the generated 2.9 V is supplied, the system controller IC907 keeps activated until the backup battery runs out even though DC IN 9V is not supplied. The output voltage of the rechargeable backup battery is supplied to MiniDisc recorder via D903 too. Then the system controller IC801 of MiniDisc recorder also starts up in the same manner as station. (Refer to section “5. MZ-R5ST MiniDisc RECORDER POWER SUPPLY CIRCUIT THEORY” for more details.) During the system backup mode, the system controller IC801 and REAL TIME CLOCK IC804 of MiniDisc recorder and the system controller IC907 of station are activated. The following data is kept memorized by the communication between the two system controller ICs.

- VOLUME setting data
- Clock setting data
- RESUME data, etc.

3. RESET operation

The RESET switch S954 is installed that allows manual reset because the system controller IC907 keeps activated until the backup battery runs out if it is started once. This RESET switch can be used to exit the service mode and for other purposes.

4. Power supply detection

Whether DC IN 9V is supplied or not is detected by pin② [ACIN] of IC907 because the system controller IC907 keeps activated until the backup battery runs out if it is started once. (“L”: when DC IN 9V is supplied.) When DC IN 9V is supplied and pin② [ACIN] of system controller IC907 goes to “L” while the system backup power is also supplied, the status signal telling that DC IN 9V is supplied, is output from pin⑥ [SD00] of IC907 to the system controller IC801 of MiniDisc recorder in the form of serial data. When IC801 receives the serial data, the reset operation is performed in the MiniDisc recorder.

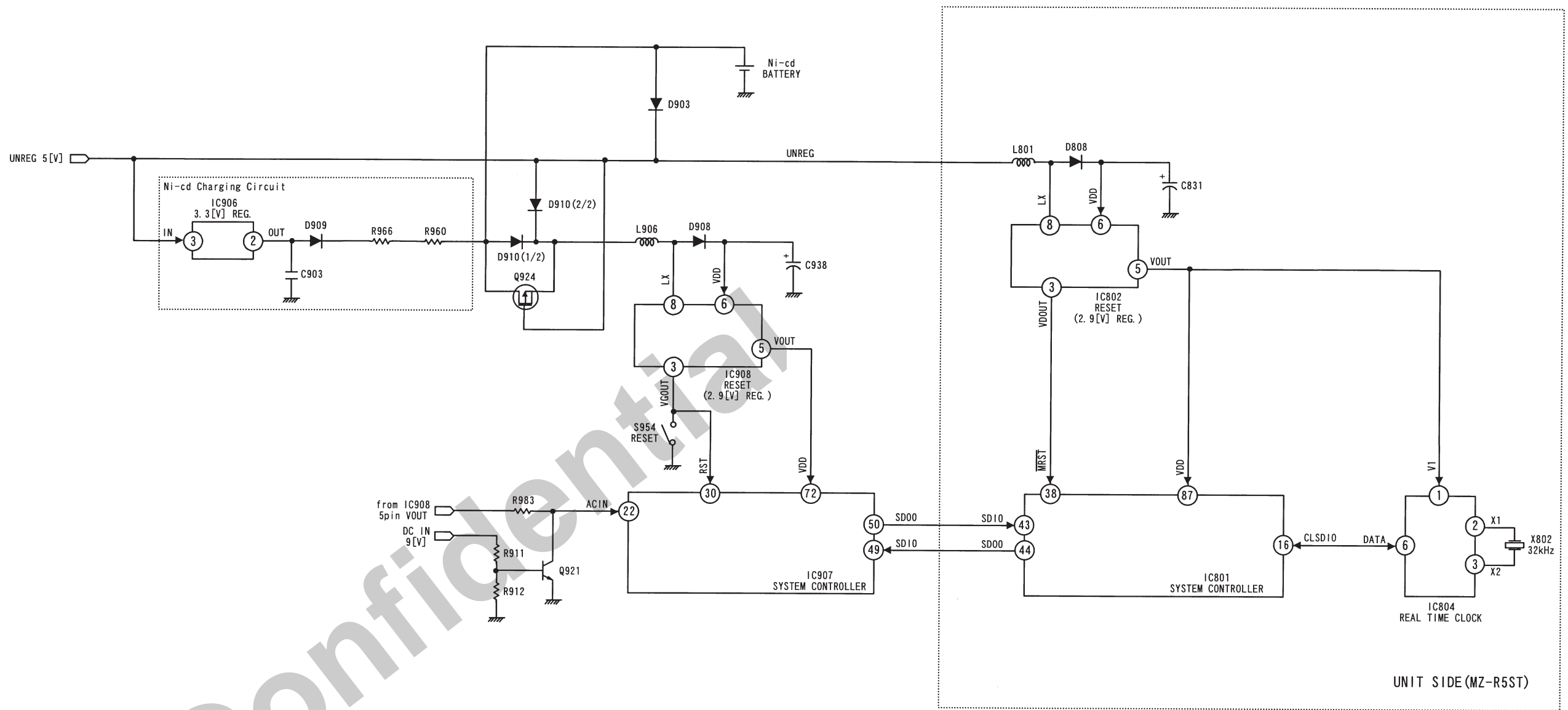


Fig. 3-11 System backup circuit

3-6. Key Input and Switch Detection

Fig. 3-12 shows block diagram of the key input and switch detection circuit of station. The system controller IC907 detects that any of the key switches is pressed, by performing detection shown in Table 3-3 through Table 3-8. Result of detection of the keys and switches that are shaded in these tables can also be checked when the service mode is used. Refer to service manual for more details.

Table 3-3 Detection switches

Switch No.	Switch Name	System control IC detect pin	Contents of Detection
S630	PANEL DOWN	Pin③ [PANEL DOWN]	Detect whether panel of LCD is closed or not. (“L”: During PANEL DOWN)
S609	POWER	Pin②⑨ [POWER KEY]	POWER key detection switch
S610	PLAY KEY	Pin②⑥ [PLAY KEY]	PLAY key detection switch
S611	REC KEY	Pin②⑦ [REC KEY]	REC key detection switch
S612	LINE-OPT1-OPT2	Pin⑦④ [LINEOPT1] Pin⑦⑤ [LINOPT2]	Input sound source selector switch
S613	PLAY-OFF-REC	Pin⑤④ [TIMER1] Pin⑤⑤ [TIMER2]	Timer setting detection switch
S614	SYNCREC	Pin⑦⑥ [SYNCREC]	Synchro recording detection switch (“L”: When selecting synchro recording)
S951	XLION	Pin②③ [XLION]	Presence or absence of lithium battery of station (“L”: Presence)
S953	RELEASE	Pin②④ [XRELEASE]	RELEASE key detection switch
S952	CLOCK SET	Pin②⑧ [CLOCK KEY]	CLOCK SET key detection switch
S655	XLOCK	Pin②⑤ [XLOCK]	Whether MiniDisc recorder is fixed to station or not. (“L”: When MZ-R5ST is connected to station (MZS-R5ST))
S656	XINT	Pin⑥① [XINIT]	Detect the initial position of MiniDisc. (“H”: When MZ-R5ST is connected to station (MZS-R5ST))

Table 3-4 List of KEY0 input voltage

Switch No.	Switch Name	13 IC907 pin③⑧ [KEY0]
S604	STOP	0 [V]
S605	REW	0.4 [V]
S606	FF	0.8 [V]
S607	PAUSE	1.2 [V]
S608	END.S	1.7 [V]

Table 3-5 List of KEY1 input voltage

Switch No.	Switch Name	IC907 pin③⑨ [KEY1]
S618	DISPLAY	0 [V]
S619	MODE	0.4 [V]
S620	UNDO	0.8 [V]
S621	TRACK MARK	1.2 [V]
S622	MOVE	1.7 [V]
S623	ERASE	2.1 [V]

Table 3-6 List of KEY2 input voltage

Switch No.	Switch Name	C907 pin④⑩ [KEY2]
S624	TITLE/ENTER	0 [V]
S625	SELECT	0.4 [V]
S626	CS+	0.8 [V]
S627	CS-	1.2 [V]
S628	UP	1.7 [V]
S629	DOWN	2.1 [V]

Table 3-7 List of KEY3 input voltage

Switch No.	Switch Name	IC907 pin④⑪ [KEY3]
S601	TREC	0 [V]
S602	VOL+	0.4 [V]
S603	VOL-	0.8 [V]

Table 3-8 List of KEY4 input voltage

Switch No.	Switch Name	IC907 pin④⑫ [KEY4]
S615	CAPS	0 [V]
S616	RIGHT	0.4 [V]
S617	LEFT	0.8 [V]

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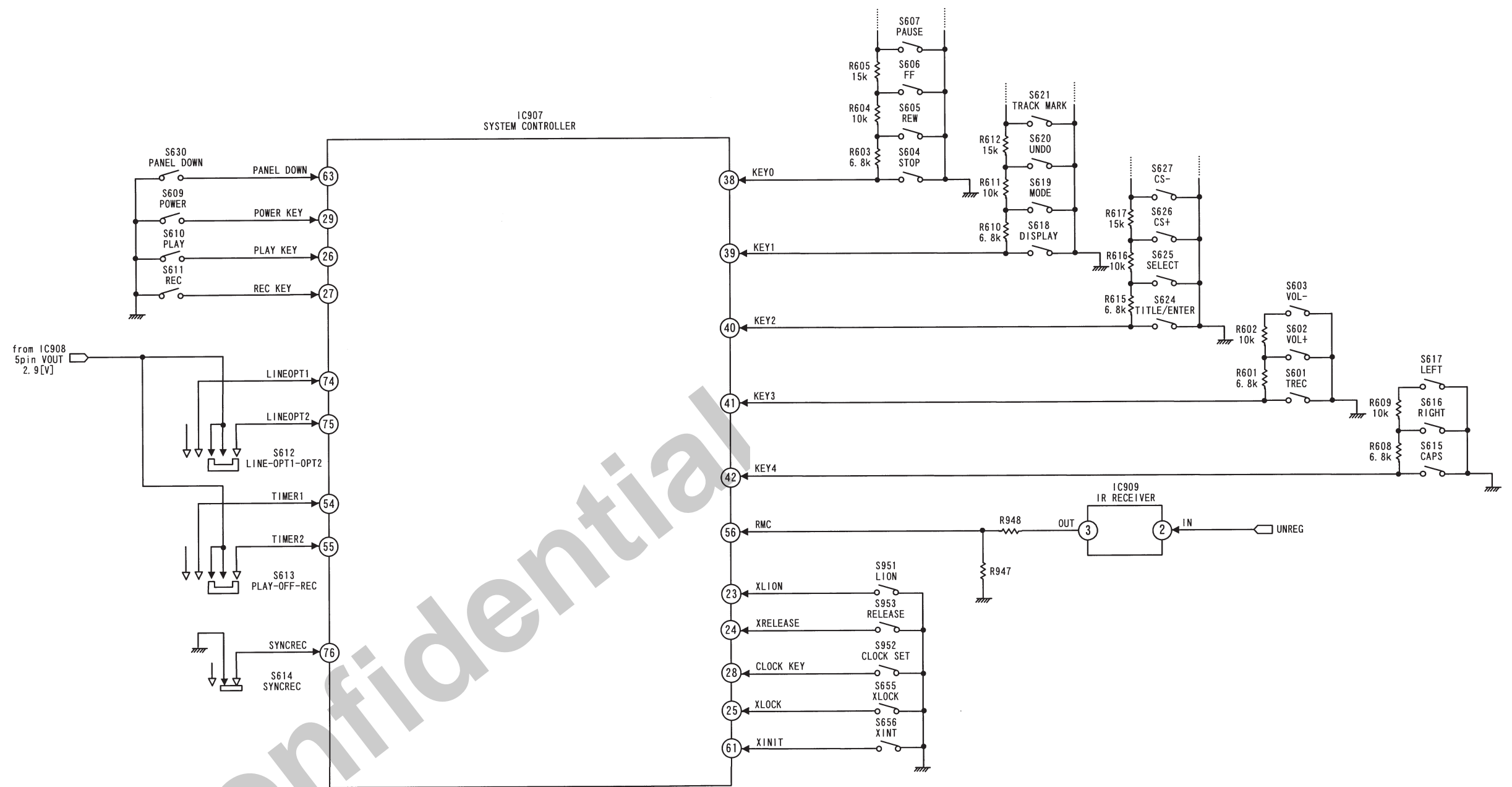


Fig. 3-12 Block diagram of the key input and switch detection circuit (MZS-R5ST)

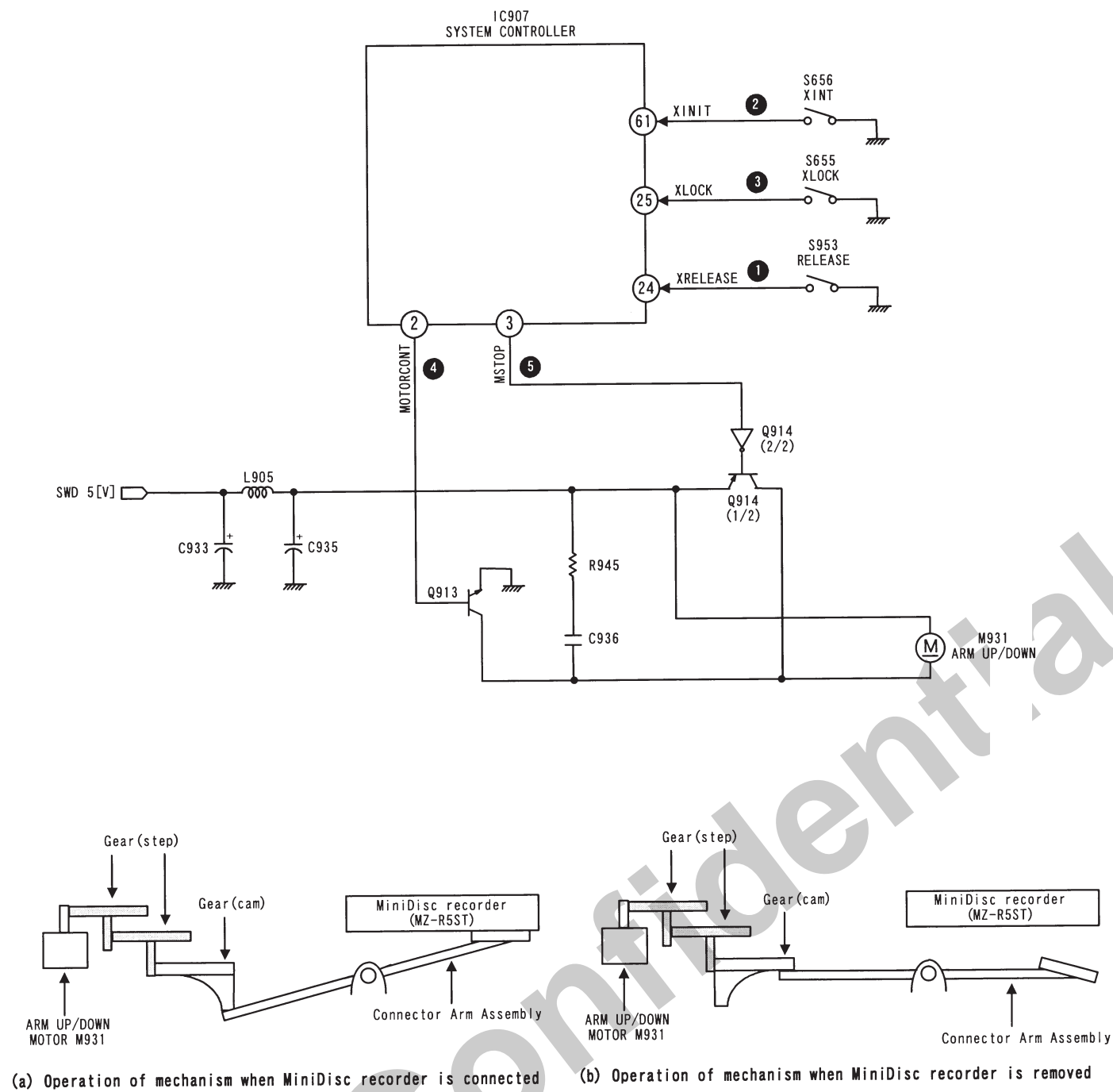
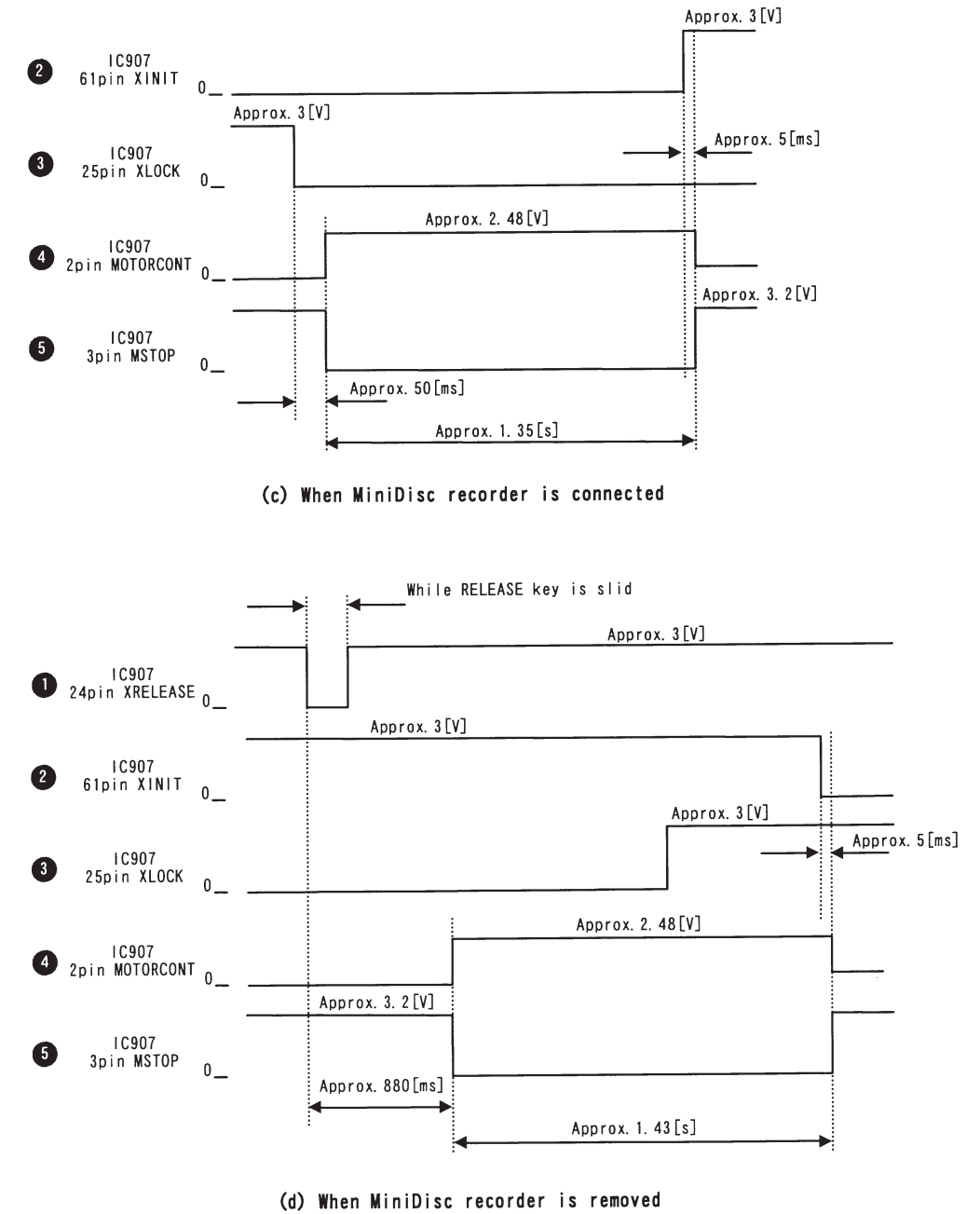


Fig. 3-13 Block diagram of the MiniDisc recorder connection and removal



3-7. MiniDisc Recorder Connection and Removal

Fig. 3-13 shows the connection and removal circuit of MiniDisc recorder.

(1) Operation when MiniDisc recorder is connected to station

When MiniDisc recorder is connected to station, “L” signal is input to pin²⁵ [XLOCK] of system controller IC907. When IC907 detects that “L” signal is input to Pin²⁵ [XLOCK], it outputs “H” from pin² [MOTORCONT] and “L” from pin³ [MSTOP]. These output signals turn on Q913 and turn off Q914 (1/2) to start rotation of the arm up/down motor M931. As the arm up/down motor M931 rotates, the gear (step) and gear (cam) are driven by this motor rotation. The gear (cam) has protrusion. When MiniDisc recorder is connected to station, this gear (cam) overrides the connector arm assembly. (Refer to (a) in Fig. 3-13.) As the connector arm assembly overrides, the connector arm assembly moves upwards so that MiniDisc recorder is connected to station. At this state, XINT SW656 is set to the “un-pressed” state so that input to pin⁶ [XINIT] of the system controller IC907 goes to “H”. As the system controller IC907 detects that input to pin⁶ [XINIT] goes to “H”, it outputs “L” from pin² [MOTORCONT] and “H” from pin³ [MSTOP] so that rotation of the arm up/down motor M931 is stopped.

Fig. 3-13 (c) shows the timing when MiniDisc recorder is connected to station.

(2) Operation when MiniDisc recorder is removed from station

When the RELEASE key is slid to right direction, input to pin²⁴ [XRELEASE] of the system controller IC907 goes to “L”. When the “L” is input to pin²⁴ [XRELEASE], it outputs “H” from pin² [MOTORCONT] and “L” from pin³ [MSTOP]. These output signals turn on Q913 and turn off Q914 (1/2) to start rotation of the arm up/down motor M931. As the arm up/down motor M931 rotates, the gear (step) and gear (cam) are driven by this motor rotation. The gear (cam) has protrusion. When MiniDisc recorder is removed from station, this gear (cam) removes the connector arm assembly. (Refer to (b) in Fig. 3-13.) As the connector arm assembly is removed, the connector arm assembly moves downwards so that MiniDisc recorder is disconnected from station. At this state, XINT SW656 is set to the “pressed” state so that input to pin⁶ [XINIT] of the system controller IC907 goes to “L”. As the system controller IC907 detects that input to pin⁶ [XINIT] goes to “L”, it outputs “L” from pin² [MOTORCONT] and “H” from pin³ [MSTOP] so that rotation of the arm up/down motor M931 is stopped.

Fig. 3-13 (d) shows the timing when MiniDisc recorder is removed from station.

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3-8. Mute Circuit

Fig. 3-14 shows block diagram of the mute circuit (MZS-R5ST). The mute circuit is activated when any of the following three conditions is satisfied.

■ Conditions

- ① When any key such as STOP/ PAUSE / FF is operated (Mute control by pin⑨③[AMUTE] of the system controller IC801 of MiniDisc recorder)
- ② When MiniDisc recorder is removed and when station is used as a stand-alone unit (Mute control by pin⑦① [PMUTE] of the system controller IC907 of station)
- ③ When DC plug is removed from station (Mute control by the voltage detector IC316)

The mute circuit operation under the respective conditions is described respectively. Because the L-channel and the R-channel use the same circuit configuration, only the flow of L-channel signal is described below.

(1) Mute circuit operation under the above described condition ①

When MiniDisc recorder is connected to station, and when any function button such as STOP or FF button requiring the mute operation, is pressed, “H” is output from pin⑨③ [AMUTE] of the system controller IC801. Q301 and Q302 are turned “ON” by this “H” signal, and AUDIO +5 V is supplied to Q101 to Q103 so that the respective output signals are muted.

(2) Mute circuit operation under the above described condition ②

When MiniDisc recorder is removed or when station is used as a stand-alone unit, “H” is output from pin⑦① [PMUTE] of the system controller IC907. The mute circuit functions in the same way as described in the above condition ①. Also as Q304 and Q303 are turned “ON” by this “H” signal, AUDIO +5 V is supplied to Q104. And the input side of the headphones amplifier IC305 is muted too.

(3) Mute circuit operation under the above described condition ③

When DC plug is removed from station, input to pin③③ of the voltage detector IC316 goes to “L”. IC316 has the built-in power supply voltage detection circuit so that it outputs “H” when the input to its pin③③ becomes lower than 4.5 V. This “H” signal turns on the next stage N-channel MOS FET so that the pin①① potential goes to “L” which turns on Q302 to activate the mute circuit.

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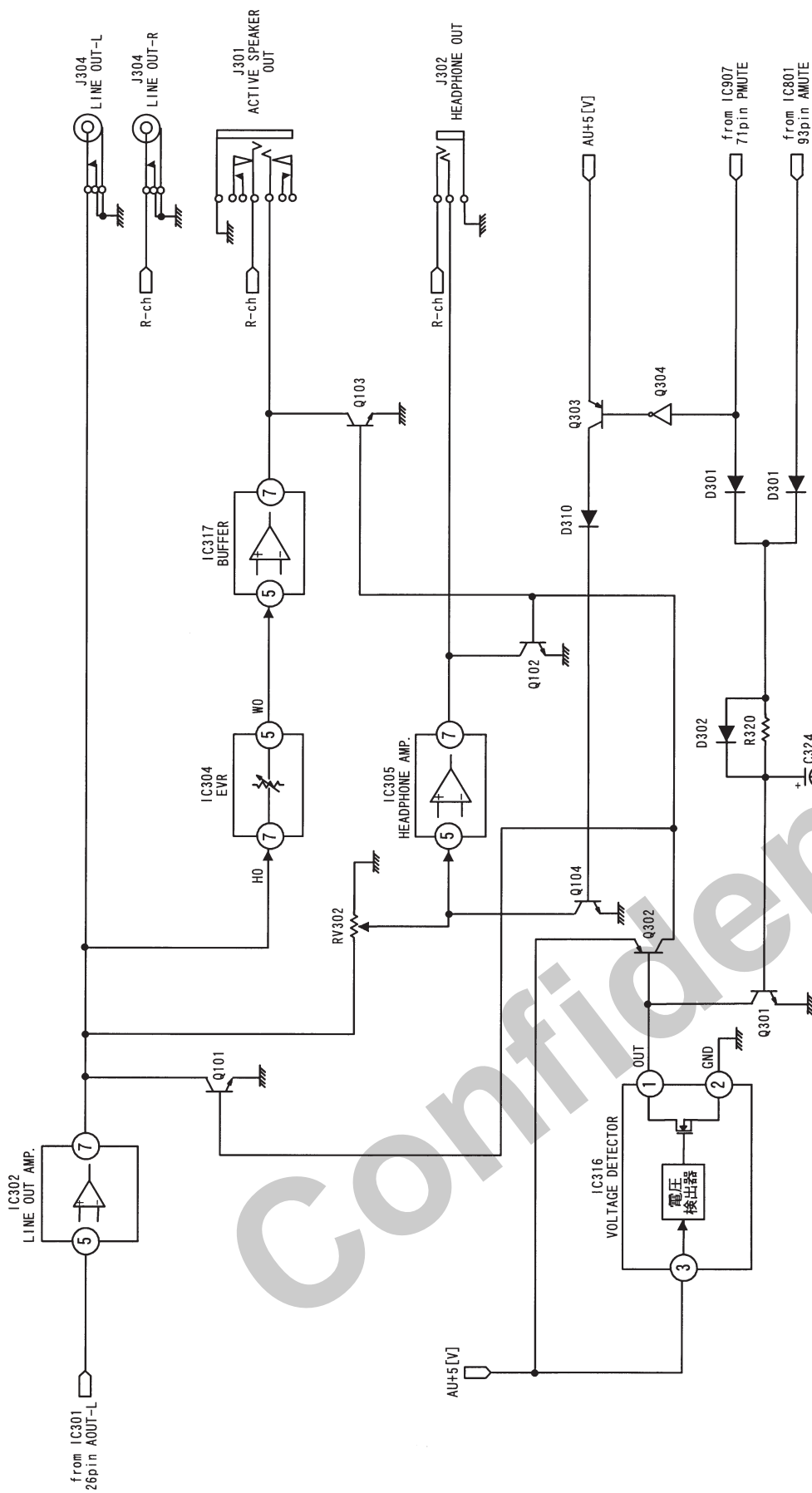


Fig. 3-14 Block diagram of the MUTE circuit (M2S-R5ST)

3-9. LCD Backlight Illuminating Circuit

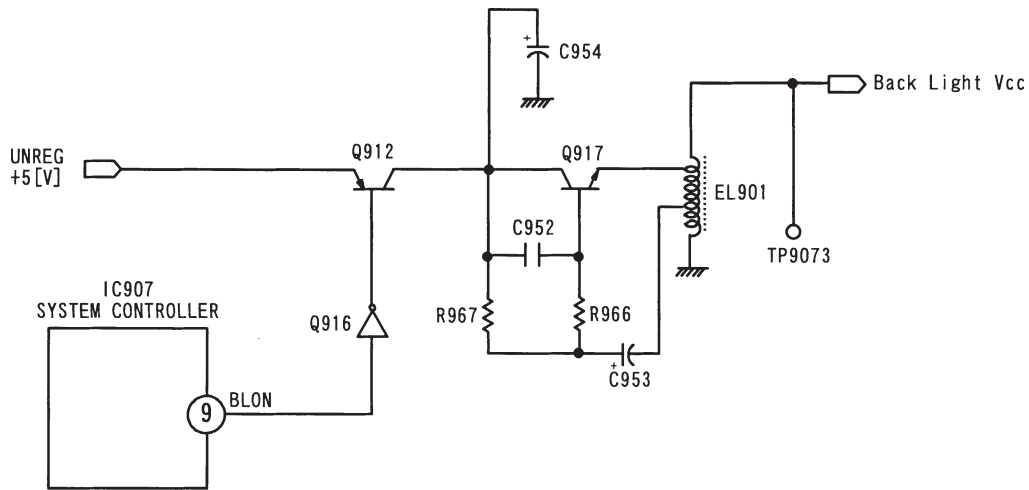


Fig. 3-15 Block diagram of the LCD backlight illuminating circuit

Fig. 3-15 shows the block diagram of the LCD backlight illuminating circuit. When the LCD backlight is turned on, “H” is output from the system controller IC907 pin⑨ [BLON]. This “H” signal turns on Q916, Q912 and Q917 so that the UNREG +5 V is supplied to EL901. Then high frequency signal is generated by the transformer EL901 and supplied to the EL element of the LCD block so that the EL element illuminates.

Oscillating waveform during normal operation is shown in Fig. 3-16.

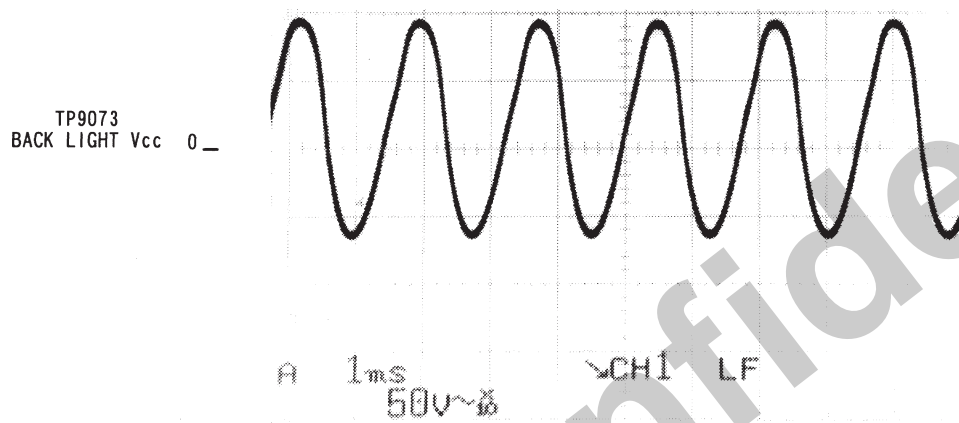


Fig. 3-16 Oscillating waveform during normal operation

3-10. Clock Adjustment

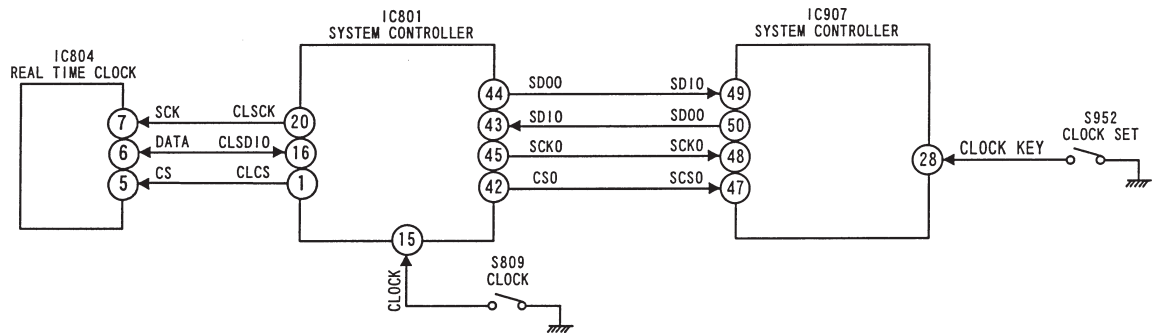


Fig. 3-17 Block diagram of clock adjustment

Fig. 3-17 shows block diagram of clock adjustment.

(1) Operation when MiniDisc recorder is connected to station

When the CLOCK SET switch S952 is pressed, input to the system controller IC907 pin²⁸ [CLOCK KEY] goes to “L”. IC907 detects that the CLOCK SET switch is pressed and at the same time establishes communication with the system controller IC801 of MiniDisc recorder so that the clock setting data is output to IC801. When IC801 receives the clock setting data, it sends the clock setting data from pin¹⁶ [CLSDIO] to the real time clock IC804 in synchronization with the clock at pin²⁰ [CLSCK] and the chip select signal at pin¹ [CLCS]. Thus clock adjustment is performed.

(2) Operation when MiniDisc recorder is used as a stand-alone unit

When the CLOCK switch S908 is pressed, input to the system controller IC801 pin¹⁵ [CLOCK] of MiniDisc recorder goes to “L”. IC801 detects that the CLOCK switch is pressed and at the same time it sends the clock setting data from pin¹⁶ [CLSDIO] to the real time clock IC804 in synchronization with the clock at pin²⁰ [CLSCK] and the chip select signal at pin¹ [CLCS]. Thus clock adjustment is performed.

(3) Operation after time is set

When MiniDisc recorder is started its operation, the system controller IC801 output the read-out command from pin¹⁶ [CLSDIO] to the real time clock IC804 in synchronization with the clock at pin²⁰ [CLSCK] and the chip select signal at pin¹ [CLCS]. When the real time clock IC804 receives the read-out command, it sends the clock data to the system controller IC801 in synchronization with the clock at pin²⁰ [CLSCK] and the chip select signal at pin¹ [CLCS] in the same manner as the data write mode. When the system controller IC801 receives the time information, it sends the time information to the system controller IC907 in synchronization with the clock that is output from pin⁴⁵ [SCK0]. Thus the respective ICs receive the time information.

4. SIGNAL CIRCUIT

The signal circuit of this unit is almost same as that of the 4th generation MiniDisc recorder MZ-R30. Therefore, only the following items are described in this manual.

- Recording circuit → The signal path up to the input stage of the DSP IC503 is described.
- Playback circuit → The signal (DA data) path after the playback signal is output from the DSP IC503 is described.

Refer to “NEW TECHNICAL THEORY FOR SERVICING, MZ-R30, OPERATION MANUAL (9-923-089-31)” for the description of the signal processing of DSP IC503 and for the description of servo circuit.

4-1. Recording Circuit

1. Operation (of DIGITAL IN/OUT circuit) during digital recording

Fig. 4-1 shows block diagram of the DIGITAL IN/OUT circuit.

(1) Selection of recording source

This unit has the two digital inputs. The recording source selector switch S612 is installed in station. Selection information of this switch is sent to the system controller IC907 pin⁷⁹ [LINEOPT1] and pin⁷⁵ [LINEOPT2]. The system controller IC907 identifies the recording source by recognizing the input as shown in Table. 4-1.

Table 4-1 Recording source selector switch S612

Recording source selector switch S612	IC907 pin ⁷⁹ [LINEOPT1]	IC907 pin ⁷⁵ [LINEOPT2]	IC907 pin ¹¹ [OPT]
Line	L	L	L
OPT1	H	L	H
OPT2	L	H	L

(2) DIN SELECTOR IC311

During digital recording, the respective digital data of each input source is input to the DIN SELECTOR IC311 pin¹³ [4B] and pin¹⁴ [4A]. Then the system controller IC907 outputs the control signal (“H”: when DIN1 is selected) from pin¹¹ [OPT], based on the result of selection of the recording source selector switch S612. The output signal from IC907 pin⁴⁶ [BUF EN] is the start-up switch signal (“L”: during starting up IC307) of the level converter 3 V to 5 V IC307.

(3) Level converter 5 V to 3 V IC313

The digital input data selected by the DIN selector IC311 is sent to the level converter 5 V to 3 V IC313. IC313 has the function to convert the signal having 5 V amplitude is converted to the signal having 3 V amplitude (exactly speaking 2.9 V amplitude) because the DSP IC503 of MiniDisc recording operates on 2.8 V. After the signal level conversion, IC313 outputs the digital data from pin³ [1Y] to the DSP IC503 pin²¹ [DIN] of MiniDisc recorder where signal processing for recording is performed. The output signal from the system controller IC907 pin¹⁰ [OPT EN] is the start-up switch signal of the level converter inside the level converter 5 V to 3 V IC313. “L” is output from the system controller IC907 pin¹⁰ [OPT EN] when the following conditions are satisfied.

- ◆ Conditions : When result of selection of the recording source selector switch S612 is either OPT1 or OPT2, and when mode of MiniDisc recorder is either REC or REC PAUSE.

(4) Operation of the digital output circuit

Firstly, the digital data that is bi-phase mark modulated inside the DSP IC503, is output from pin²² [DOUT] to the level converter of 3 V to 5 V IC307. IC307 converts the input signal having 2.8 V amplitude to the signal having 5 V amplitude that is output from pin⁶ [A5] to the DOUT terminal.

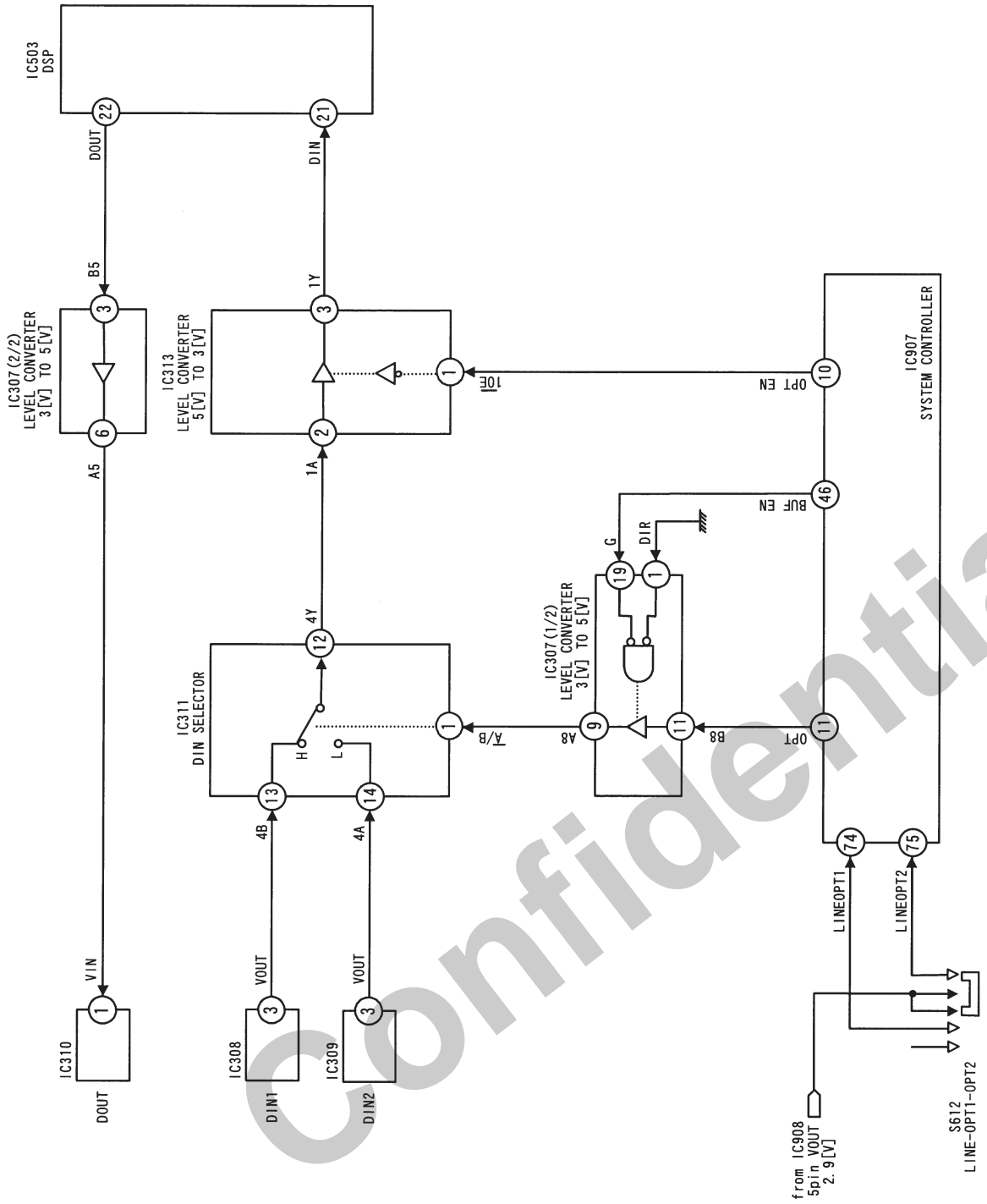


Fig. 4-1 Block diagram of the DIGITAL IN/OUT circuit

2. Operation during LINE recording

Fig. 4-2 shows block diagram of the recording circuit during LINE recording. Because the L-channel and the R-channel use the same circuit configuration, only the L-channel is described below. This unit is equipped with the differential conversion circuit at the LINE input in order to realize the same high quality sound as that of deck-type MiniDisc recorder. The differential conversion circuit improves the resolution ability when signal is A/D converted inside the AD/DA converter IC301.

When LINE is selected by the input source selector switch S612, input of the system controller IC907 pin⑭ [LINEOPT1] and pin⑮ [LINEOPT2] go to “L”, and IC907 recognizes that the input source is analog (LINE). When MiniDisc recorder enter the REC mode or the REC PAUSE mode, IC907 output “L” signal from pin⑯ [XPWAD]. Q920 is turned “OFF” by this “L” signal so that “H” is input to the AD/DA converter IC301 pin⑰ [PWAD] so that the A/D converter inside IC301 is started up.

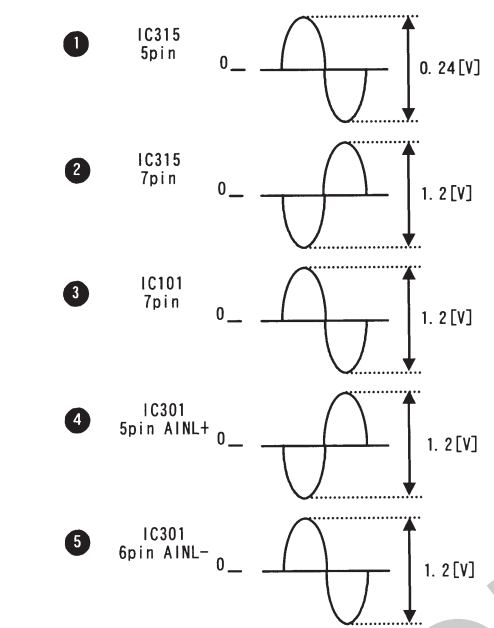
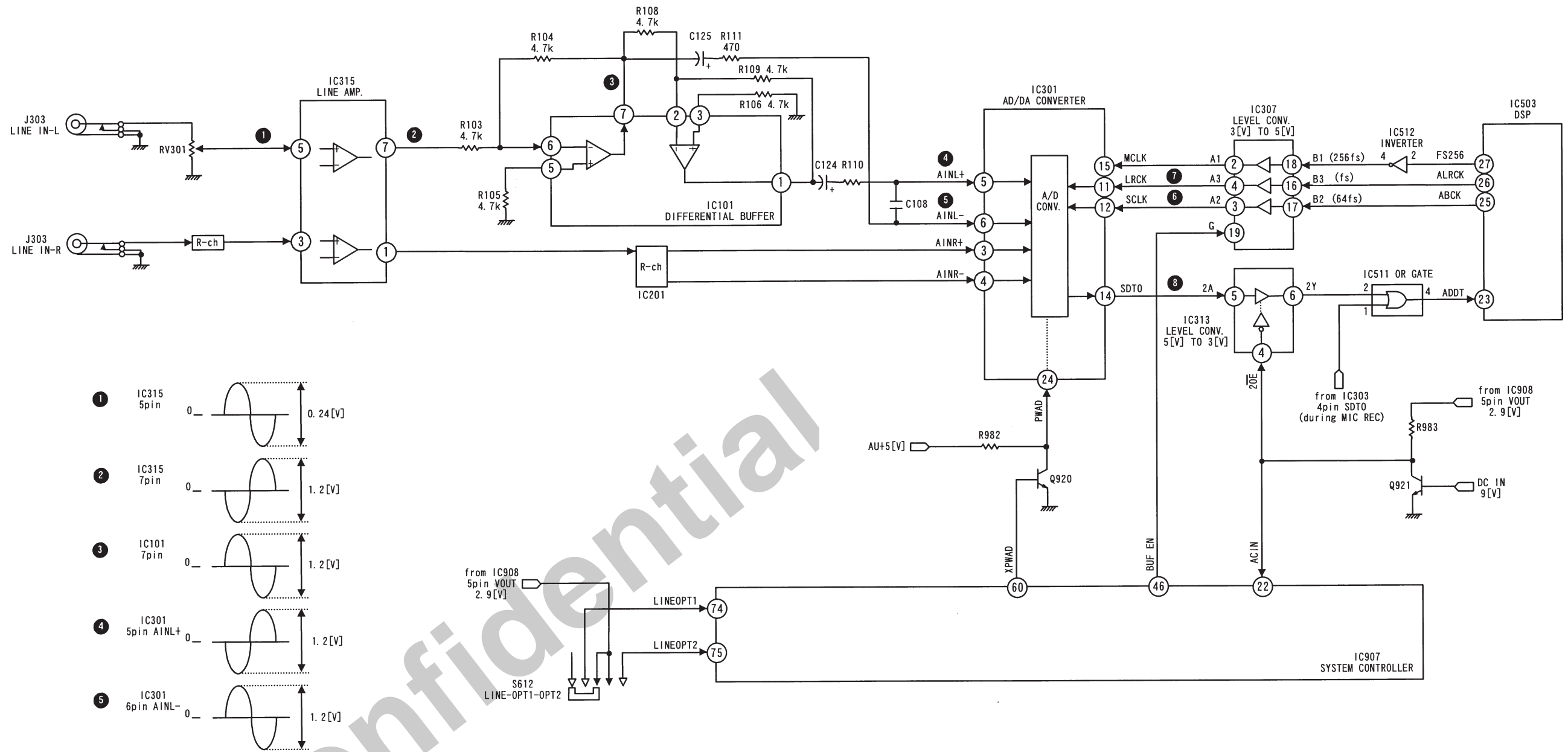
The L-channel signal flow during the LINE recording is described next. The L-channel analog signal that is input from the LINE IN jack J303 passes through the LINE amplifier IC315, the differential buffer IC101 and is sent to the AD/DA converter IC301 pin⑱ [AINL+] and pin⑲ [AINL-], then to the A/D converter inside IC301 where the input analog signal is converted to the 20-bit digital data. The generated digital data is output to the DSP IC503 alternately via the level converter IC313 and OR gate IC511 in synchronization with the LRCK (L-channel/R-channel discrimination signal) and BCK (bit clock).

The level converter IC313 has the function to convert the signal having 5 V amplitude is converted to the signal having 3 V amplitude (exactly speaking 2.9 V amplitude) because the DSP IC503 of MiniDisc recording operates on 2.8 V. During LINE recording, Q921 is turned on by the DC IN 9 V that is supplied to station so that the input to IC313 pin⑳ [2OE] is set to “L”. This “L” signal activates the level converter circuit inside IC313.

Fig. 4-2 (a) shows the waveform timing chart when the following conditions are satisfied. Fig. 4-3 shows the waveform timing of IC301 output side.

- ◆ Input sound source : 1 kHz, 0 dB signal
- ◆ Recording level : Adjusted around -2 dB by the REC volume.

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(a) Waveform timing chart when input signal is 1kHz, 0dB

Fig. 4-2 Block diagram of the recording circuit during LINE recording

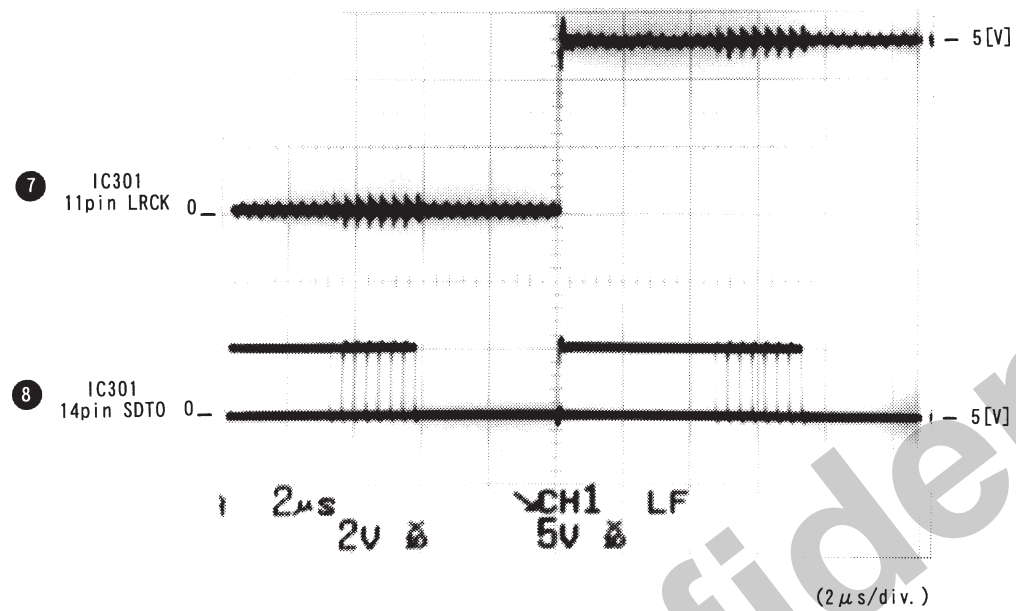
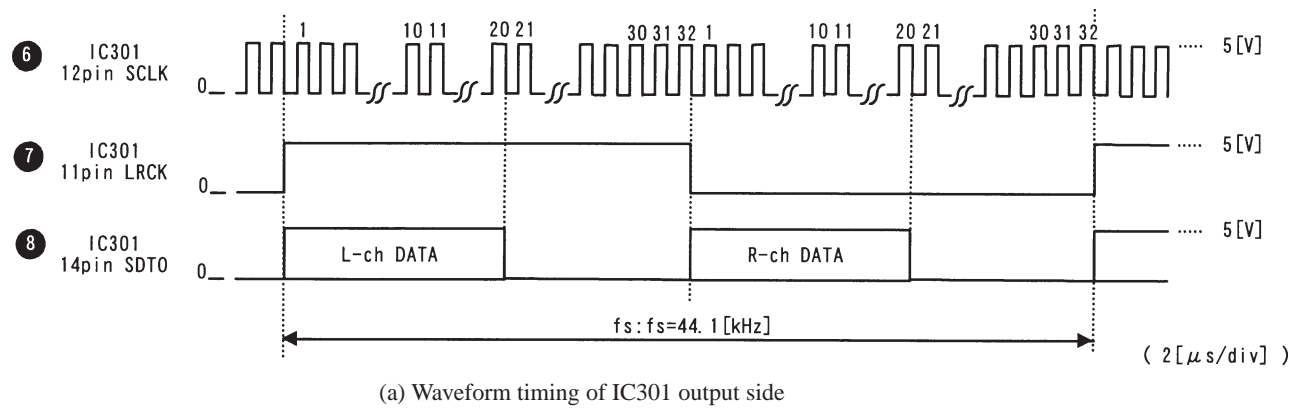


Fig. 4-3 Waveform timing of IC301 output side

3. Operation during MIC recording

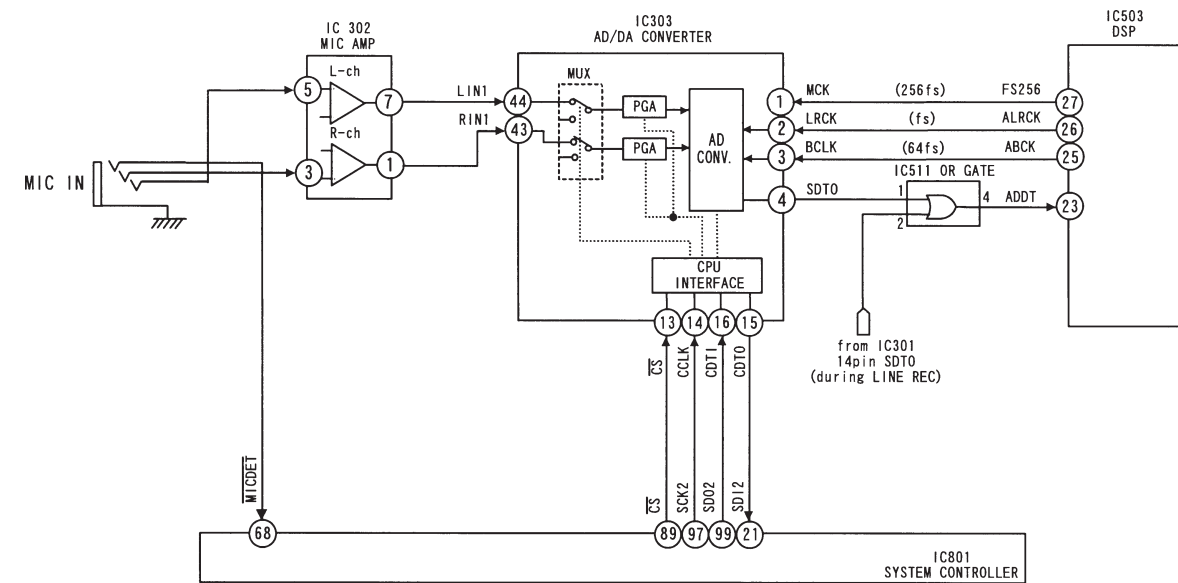


Fig. 4-4 Block diagram of the recording circuit during MIC recording

Fig. 4-4 shows the block diagram of the recording circuit during MIC recording.

The analog signal that is input from the MIC IN jack is amplified by the microphone amplifier IC302 and input to the AD/DA converter IC303 pin④④ [LIN1] and pin④③ [RIN1]. The input analog signal is amplified by PGA (Programmable Gain Amplifier) inside IC303, then input to A/D converter in IC303 where the input analog signal is converted to the 16-bit digital data. The generated digital data is output to the DSP IC503 alternately in synchronization with the LRCK (L-channel/R-channel discrimination signal) and BCK (bit clock). In the AD/DA converter IC303, the internal multiplexer receives the serial command (input source selection command and others) from the system controller IC801 pin⑨ [SD02] and selects the input source. Because MiniDisc recorder uses the A/D converter inside the AD/DA converter IC303 only during MIC recording, IN1 is always selected as the input source. The AD/DA converter IC303 has the built-in PGA (Programmable Gain Amplifier) which is used to enable either AUTO gain mode recording or MANUAL gain mode recording during MIC recording. PGA adjusts the MIC gain by means of software during the AUTO mode, and adjusts the MIC gain in accordance with the value set by user during the MANUAL mode.

The MIC recording is possible when MiniDisc recorder is operated without station. When MiniDisc recorder is connected to station (MZR-R5ST), the MIC recording is not possible.

4-2. Playback Circuit

(1) Basic configuration of playback circuit

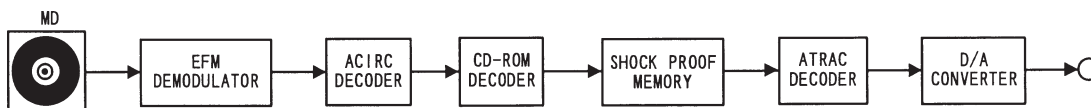


Fig. 4-5 Playback circuit basic block diagram

Fig. 4-5 shows the playback circuit basic block diagram of MiniDisc system. The RF data that is read by the optical block is EFM-demodulated by the EFM demodulator, and is performed the error detection and error correction by the ACIRC decoder. Because the MiniDisc data has the same data structure as that of CD-ROM format, the RF signal is decoded by the CD-ROM decoder. Then the ATRAC data that is obtained by decoding has already compressed into 1/5 of original data, and is stored once in the shock proof memory (buffer RAM). This memory stores not only the ATRAC data but also the error information (C2PO) and TOC/UTOC information too. Next, the ATRAC data that is periodically read out from the shock proof memory, is expanded to the 16-bit or 20-bit linear data by the next stage ATRAC decoder. The ATRAC data is then converted to analog signal by the next stage D/A converter.

(2) Playback circuit

Fig. 4-6 shows block diagram of the playback circuit, when MiniDisc recorder is connected to station. The DA data that is output from the DSP IC503 of MiniDisc recorder is sent to the AD/DA converter IC301 via the level converter 3 V to 5 V IC 307. The DA data is converted to the L-channel and R-channel analog signal by D/A converter located inside IC301. The output analog signal is sent to the LINE OUT jack J304 via the LINE OUT amplifier IC302, and is sent to the HEADPHONES OUT jack J302 via the LINE OUT amplifier IC302, the PB VOLUME RV302 and headphone amplifier IC305. It is also output to the ACTIVE SPEAKER OUT jack J301 via the LINE OUT amplifier IC302, EVR IC304 and buffer IC317.

Regarding the signal output to MiniDisc recorder (MZ-R5ST), signal flow of L-channel signal only is described below. When MiniDisc recorder is connected to station, you can listen to sound from the HEADPHONES output of MiniDisc recorder. The headphone output signal is created as follows. The analog signal that is output from the AD/DA converter IC301 is sent to the audio gain amplifier IC305 via differential amplifier consisting of IC330, IC130 and IC131. After the audio volume is controlled by the audio gain control IC305 and by the communication with the system controller IC801, the audio signal is output from the HEADPHONES OUT jack J302 via the headphone amplifier IC805.

(3) System controller IC907

It controls the output signal during playback as shown in Table 4-2.

Table 4-2 Control signals during playback

	IC907 pin ⁽⁴⁶⁾ [BUF EN]	IC907 pin ⁽⁶⁰⁾ [XPWDA]	IC907 pin ⁽¹⁾ [DEEMP]	IC907 pin ⁽⁷⁸⁾ [DIFO]	IC907 pin ⁽⁷⁹⁾ [DIF1]
H	IC307 during STOP	D/A converter during STOP	De-emphasis during OFF	—	When the main power is ON
L	IC 307 during START	D/A converter during START	De-emphasis during ON	Constant “L”	When the main power is OFF

When MiniDisc system is operated, the system controller IC907 outputs “L” from pin⑳ [DIF0] and “H” from pin㉑ [DIF1]. These output signals are the control signal for the audio serial interface format to be used inside the AD/DA converter IC301. When these signals are sent, IC301 selects the operating mode that is specified in accordance with the input signals at pin㉒ [DIF0] and pin㉓ [DIF1]. In this unit, MODE1 is always selected.

Table 4-3 List of audio serial interface mode

MODE	IC301 pin㉒ [DIF0]	IC301 pin㉓ [DIF1]	SDTO (A/D converter)	SDTI (D/A converter)	L/R
0	L	L	20-bit, MSB, justified	16-bit, LSB, justified	H/L
1	H	L	20-bit, MSB, justified	20-bit, LSB, justified	H/L
2	L	H	20-bit, MSB, justified	20-bit, MSB, justified	H/L

When the system controller IC907 detects that the active speaker VOLUME key is pressed at pin㉔ [KEY3], IC907 outputs data from pin㉕ [EDATA] to EVR IC304 in synchronization with the clock at pin㉖ [ESCK] and the chip select signal at pin㉗ [ECS]. Output data from IC907 controls the output signal from ACTIVE SPEAKER OUT J301.

Fig. 4-7 shows the waveform timing chart of IC301 input side.

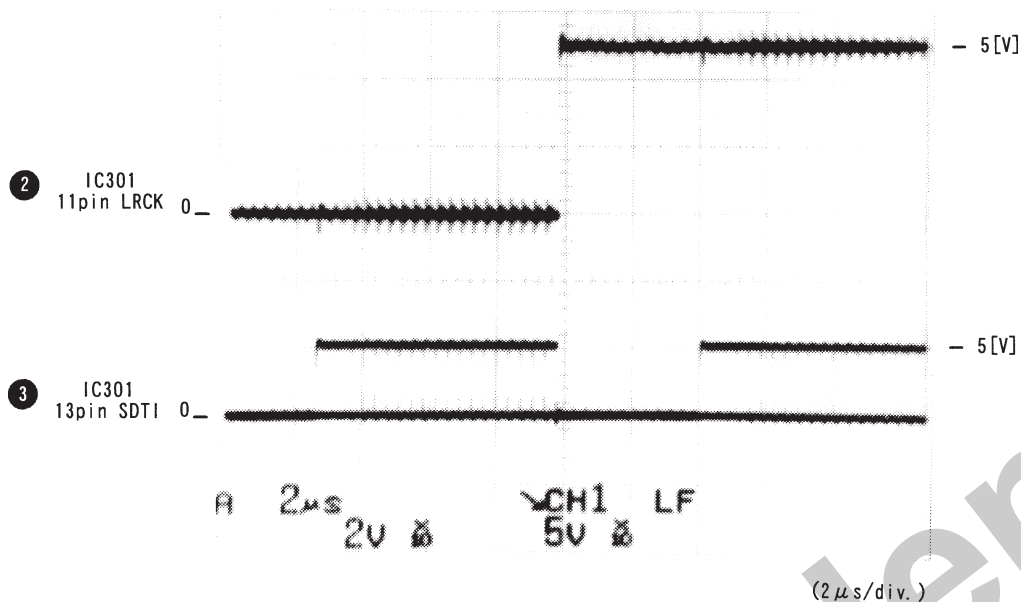
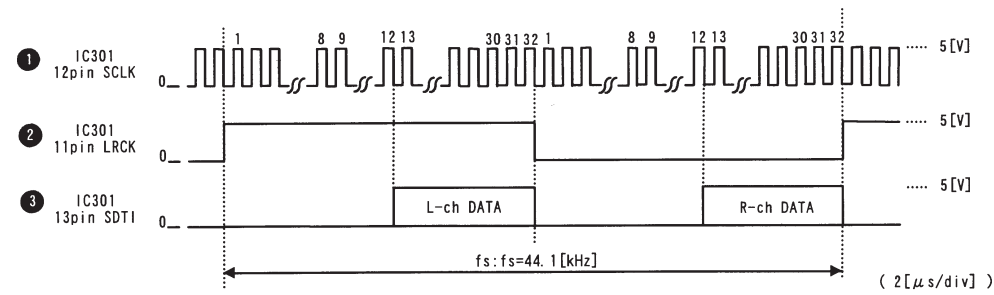


Fig. 4-7 Waveform timing chart of IC301 input side

◆ Technical tip ◆

When the WALKMAN (MiniDisc recorder MZ-R5ST) is played back as a stand-alone unit, the DBB function that is installed the WALKMAN can be used. However, when WALKMAN is connected to station, the DBB function is disabled.



(a) Waveform timing of IC301 input side

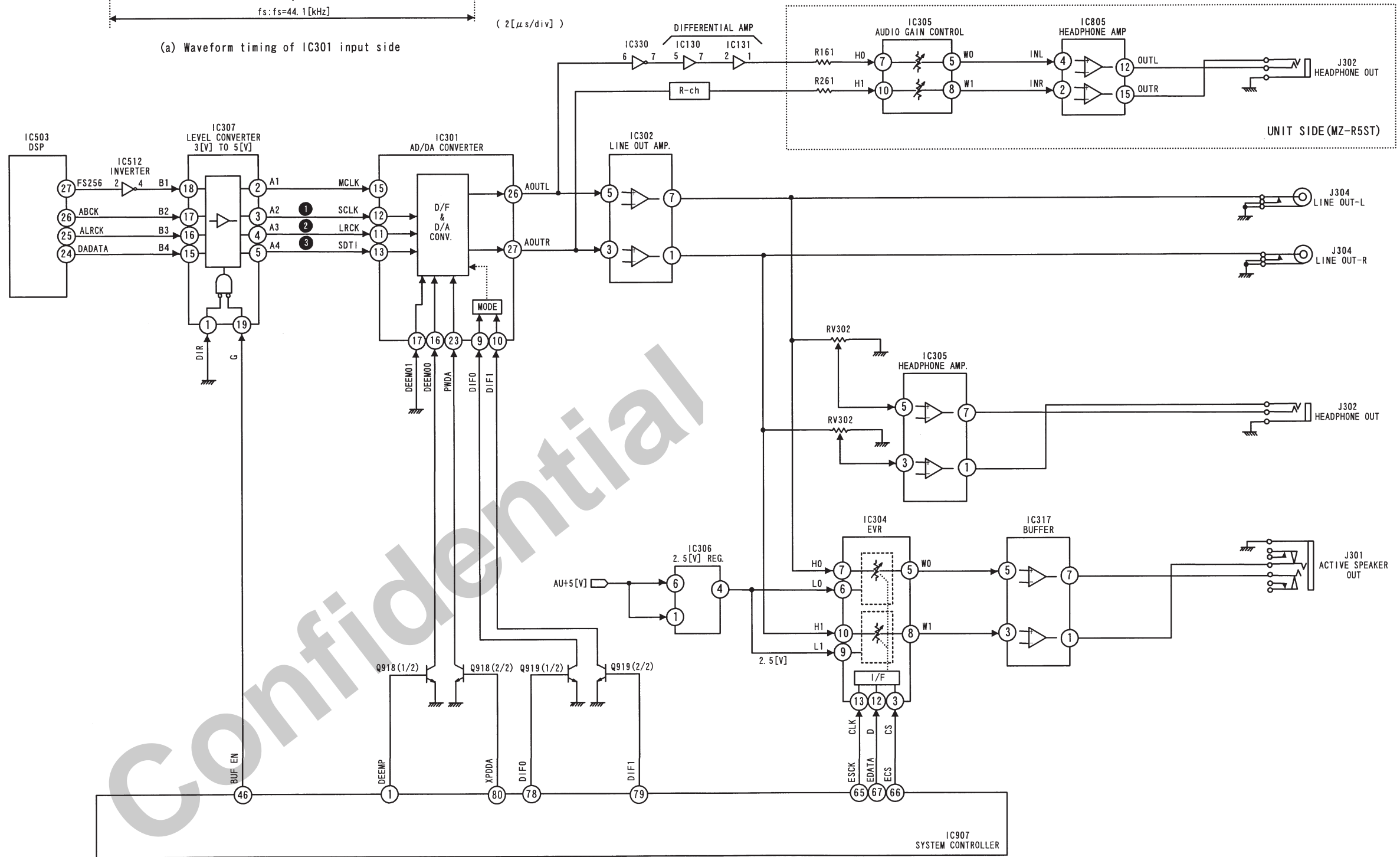


Fig. 4-6 Block diagram of the playback circuit

5. MZ-R5ST MiniDisc RECORDER POWER SUPPLY CIRCUIT THEORY

5-1. Types of Power Supply

MiniDisc recorder can be operated on the four kinds of power supply as shown below.

- ◆ When MiniDisc recorder is connected to station:
 - AC adapter 9.0 V (supplied)
- ◆ When MiniDisc recorder is used as a stand-alone unit:
 - Rechargeable lithium-ion battery (LIP-8) 3.7 V (supplied)
 - Dry cell battery (size AA, 2 pcs) 3.0 V (optional)
 - Rechargeable nickel-hydrogen battery (BP-DM20) 2.4 V (optional)

Table 5-1 shows the operating hours of each type of battery.

Table 5-1 Comparison of battery operating hours (MZ-R30, MZ-R5ST)

No.	Battery	MZ-R30		MZ-R5ST	
		During recording	During playback	During recording	During playback
1.	Rechargeable lithium-ion battery (LIP-12 (H))	For about 5 hours	For about 8 hours	—	—
2.	Rechargeable lithium-ion battery (LIP-8)	—	—	For about 3.5 hours	For about 5.5 hours
3.	SONY alkaline dry cell (LR6 (size AA) 2 dry cells)	For about 3 hours	For about 6.5 hours	For about 4.5 hours	For about 9 hours
4.	Rechargeable nickel-hydrogen battery (BP-DM20)	For about 3 hours	For about 4.5 hours	For about 4.5 hours	For about 6.5 hours
5.	1+3	For about 8.5 hours	For about 15 hours	—	—
6.	2+3	—	—	For about 8 hours	For about 16 hours
7.	1+4	For about 8.5 hours	For about 14.5 hours	—	—
8.	2+4	—	—	For about 8 hours	For about 13 hours

5-2. Identifying Power Supply

The system controller IC801 identifies from which the main power is supplied, immediately after it is started up. When any battery outside the specifications is used, it stops operation of MiniDisc recorder. The system controller IC801 identifies the type of power supplies from the result of the three kinds of detection.

- (1) Pin⑳ [DCIN] : When MZ-R5ST is connected to station, it goes to “L”.
- (2) Pin㉑ [LIMNT (LI + MNT)] : The voltage that is obtained by voltage-dividing-resistor of the lithium-ion battery output voltage.
- (3) Pin㉒ [AM3] : The voltage that is obtained by voltage-dividing-resistor of the dry cell or nickel-hydrogen battery output voltage.

Table 5-2 List of power supply identification

	Pin⑳ [DCIN]	Pin㉑ [LIMNT]	Pin㉒ [AM3]
When MZ-R5ST is connected to station	L	L	L
When MZ-R5ST is operated on rechargeable lithium-ion battery	H	H	L
When MZ-R5ST is operated on rechargeable nickel-hydrogen battery	H	L	H
When MZ-R5ST is operated on alkaline dry cell	H	L	H

5-3. Circuit voltage

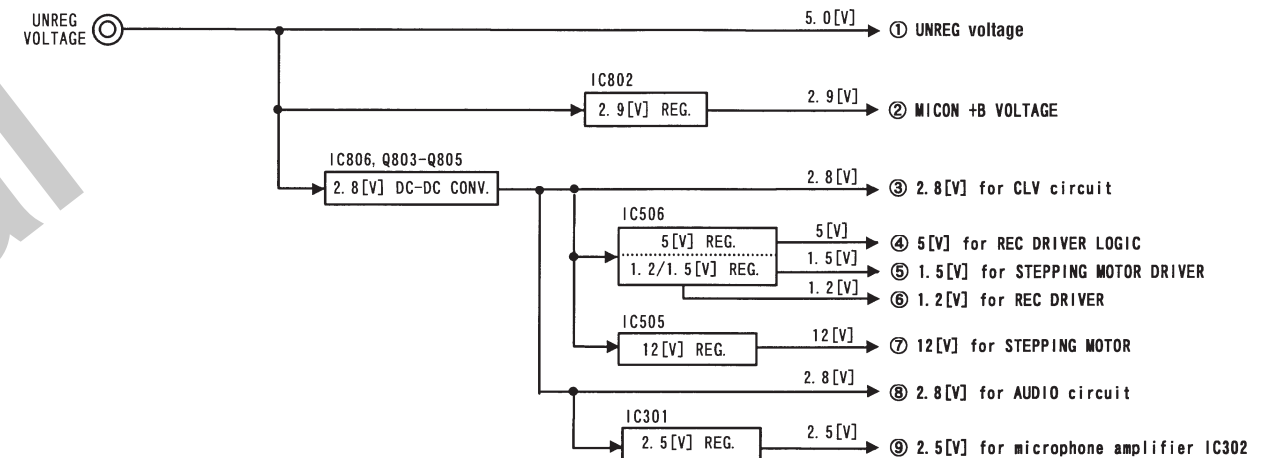


Fig. 5-1 Supply voltages generation block diagram

When MZ-R5ST is connected to station, the following nine kinds of voltage are generated by Mini Disc recorder (MZ-R5ST). (Refer to Fig. 5-1.)

- ① UNREG voltage → “Supplied from station”
 - This is 5.0 V power that is supplied from station.
 - This is 5.0 V power for the driver of the coil/motor drive IC505.
- ② MICON +B voltage → “RESET (2.9 V REG) IC802”
 - This is 2.9 V power that is used for driving the system controller IC801.
- ③ Power for CLV circuit → “2.8 V DC-DC converter (IC806, Q803 to Q805)”
 - This is 2.8 V power that is used in the CLV circuit (RF amplifier IC501, digital signal processor IC503, coil/motor drive IC505, etc.)
- ④ Power for REC DRIVE logic circuit → “ 5 V REG (IC506)”
 - This is 5.0 V power that is used for driving the logic circuit inside the REC DRIVE IC506.
- ⑤ Power for stepping motor driver → “ 1.2 V/1.5 V REG (IC506)”
 - This is 1.5 V power that is used as the H-bridge power supply for stepping motor.
- ⑥ Power for REC DRIVER → “1.2 V/1.5 V REG (IC506)”
 - This is 1.2 V power that is used as the power supply for the over-write head driver during recording.
- ⑦ Power for stepping motor → “ 12 V REG (IC505)”
 - This is 12 V power that is used for the power supply of pre-driver inside IC505.
 - This 12 V power that is used to drive stepping motor.
- ⑧ Power for audio circuit → “2.8 V DC-DC converter (IC806, Q803 to Q805)”
 - This is 2.8 V power that is used for audio circuit (AD/DA converter IC303, audio gain control IC305, etc.)
- ⑨ Power for microphone amplifier IC302 → “ 2.5 V REG (IC301)”
 - This is 2.5 V power that is used to drive the microphone amplifier IC302.

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The respective powers are described how they are generated.

1. Generating the UNREG voltage

When DC plug is connected to DC jack of station (MZS-R5ST), the UNREG 5.0 V power that is generated by the power supply circuit of station, is supplied to MiniDisc recorder. Refer to the power supply circuit description of station for more details.

2. Generating the MICON +B voltage

When the UNREG power is supplied to the RESET IC802 pin⑥ [VDD], the MICON +B voltage is generated by the step-up/step-down regulator and is output from pin⑤ [VOUT].

3. Generating the Power for CLV circuit

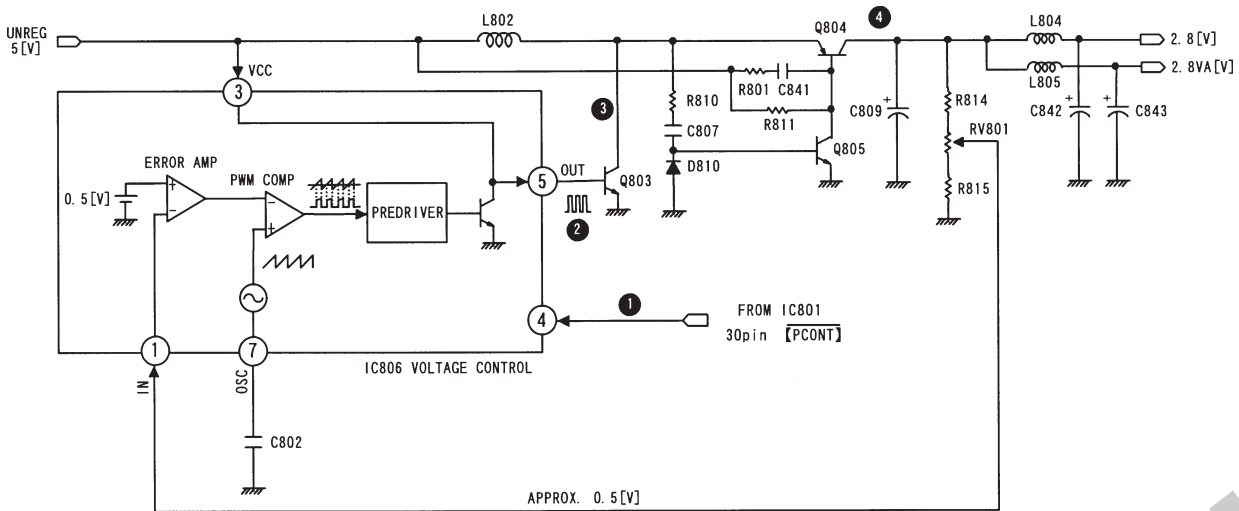


Fig. 5-2. 2.8 V DC-DC converter circuit

Fig. 5-2 shows the 2.8 V DC-DC converter circuit block diagram. The UNREG voltage is supplied to the voltage control IC806 pin③ [VCC], and when output from the system controller IC801 pin⑩ [PCONT] goes to “L”, IC806 starts up. When IC806 starts up, PWM waveform that is generated by the internal PWM comparator is output from pin⑤ [OUT].

The PWM waveform is sent to Q803, Q804 and Q805 which start switching operation, and the step-down DC-DC converter circuit starts up too. Output of Q804 is smoothed out by C809, divided by the voltage-divider resistor of R814, RV801 and R815. Output voltage obtained by the voltage-divider resistor is fed back to IC806 pin① [IN]. Based on this feedback voltage, IC806 controls the voltage by controlling the PWM waveform duty generated by the PWM converter inside. Thus the 2.8 V power for CLV circuit and 2.8 V power for audio circuit are generated.

The SLEEP function is described next. The SLEEP function is used in order to realize the low power consumption when MiniDisc is operated on battery such as rechargeable lithium-ion battery. When about ten seconds have passed after MiniDisc recorder enter the STOP state, IC806 is stopped of its operation by setting pin⑩ [PCONT] output to “H”. The 2.8V DC-DC converter is stopped by this “H” signal.

Fig. 5-3 shows the waveform timing of the 2.8 V DC-DC converter circuit.

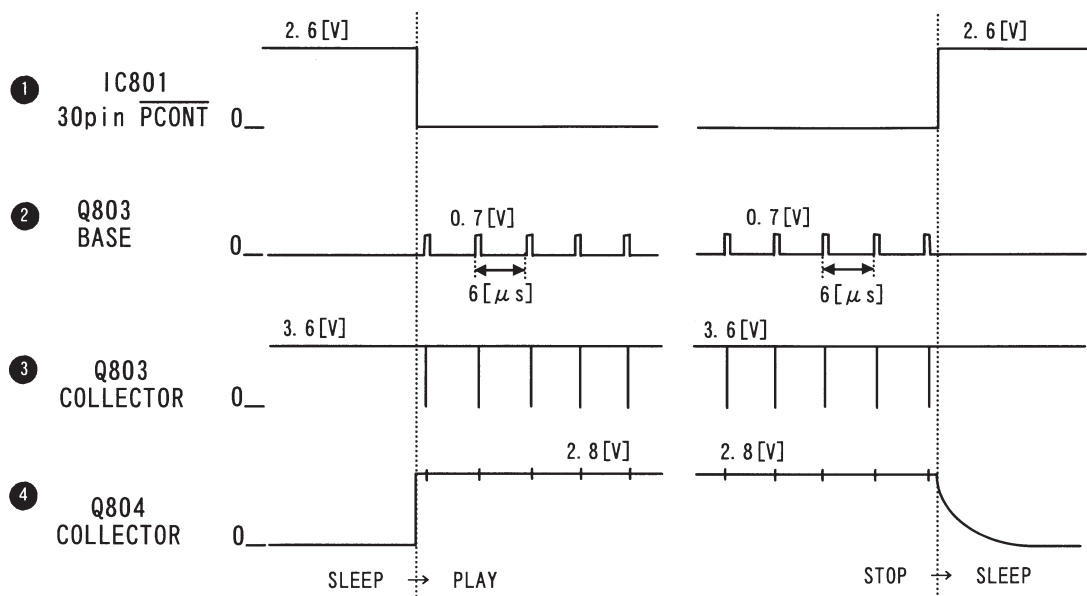


Fig. 5-3 Waveform timing chart (When MiniDisc is operated on rechargeable lithium-ion battery)

4. Generating the REC DRIVE logic voltage

5 V is generated from the CLV circuit voltage 2.8 V by the step-up converter consisting of the REC DRIVE IC506 pin⑦ [VG], L514, D502 and C565. The generated 5 V is used for the logic circuit inside IC506.

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5. Generating the power for stepping motor/REC driver

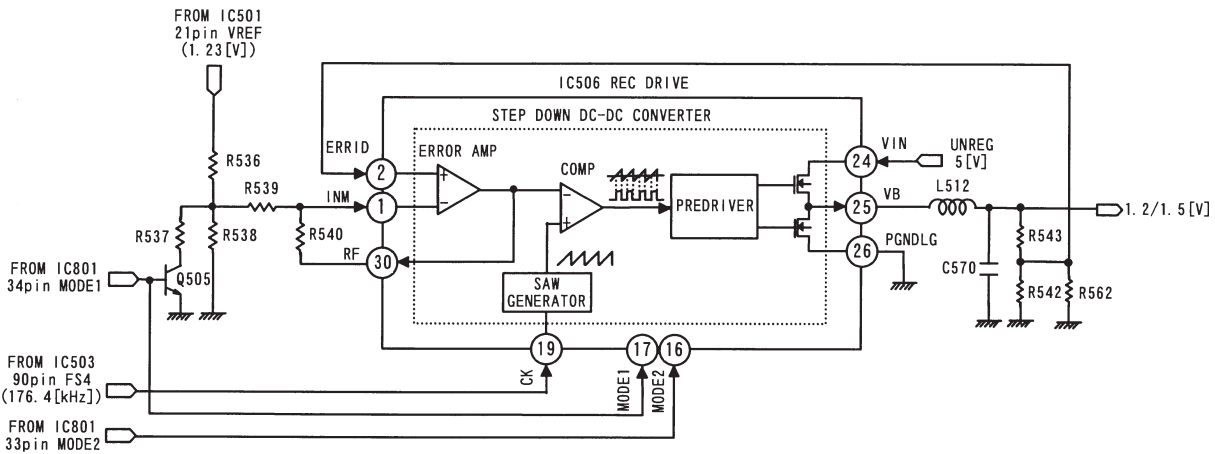


Fig. 5-4 1.2 V/1.5 V regulator block diagram

Fig. 5-4 shows block diagram of the 1.2 V/1.5 V regulator circuit. The mode setting table of the REC DRIVE IC506 is shown in Table 5-3. IC506 switches the internal operating mode according to the control signal output from pin³⁴ [MODE1] and pin³³ [MODE2] of the system controller IC801 as shown in the table. When stepping motor is activated, the system control IC801 outputs “L” signal from pin³⁴ [MODE1] and also “L” from pin³³ [MODE2]. Q505 is turned “OFF” by this “L” signal. As a result, the step-down regulator inside IC506 becomes the 1.5 V regulator, and 1.5 V is output from pin²⁵ [VB] of IC506.

Next, during recording mode, the system controller IC801 outputs “H” signal from pin³⁴ [MODE1] and “L” from pin³³ [MODE2]. Q505 is turned “ON” by this “H” signal. As a result, the step-down regulator inside IC506 becomes the 1.2 V regulator, and 1.2 V is output from pin²⁵ [VB] of IC506. Thus the step-down regulator inside IC506 is switched of its operation by changing the reference voltage of error amplifier as Q505 is turned on or off.

At the same time, the sawtooth wave that is generated internally by IC506, is generated based on 176.4 kHz signal which is output from the digital signal processor IC503 pin⁹ [FS4].

Table 5-3 List of IC506 mode settings

MODE 1	MODE 2	STEP UP REG	STEP DOWN REG	EFM logic block	Operation mode
H	H	STOP	STOP	STOP	During STOP and PLAY
L	H	POWER ON	STOP	STOP	Not used
L	L	POWER ON	POWER ON 1.5 V output	STOP	When stepping motor is operating
H	L	POWER ON	POWER ON 1.2 V output	POWER ON	During recording

6. Generating the power for stepping motor

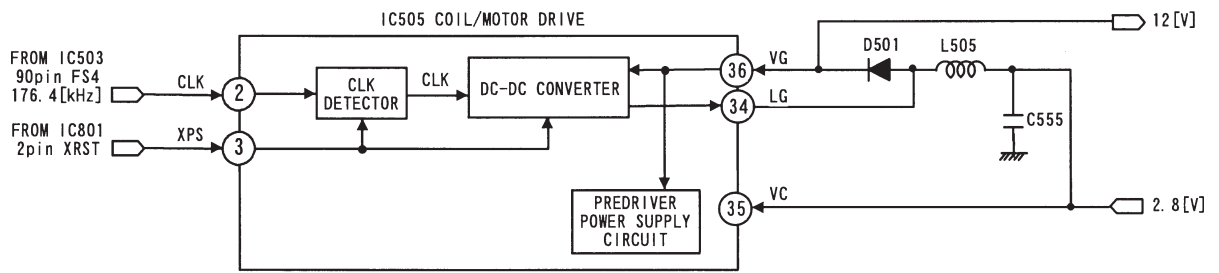


Fig. 5-5 12 V DC-DC converter circuit

Fig. 5-5 shows block diagram of the 12 V DC-DC converter. The coil/motor drive IC505 has the 12 V DC-DC converter internally in it. The 12 V DC-DC converter starts operating when coil (L505), switching diode (D501) and smoothing capacitor (C555) are externally connected. The 12 V DC-DC converter generates the power supply voltage to be used by the pre-driver inside IC505, and the 12 V power supply voltage for stepping motor. This 12 V DC-DC converter operates in synchronization with the clock (176.4 kHz) supplied from the digital signal processor IC503 pin^⑩ [FS4].

7. Generating the power for microphone amplifier IC302

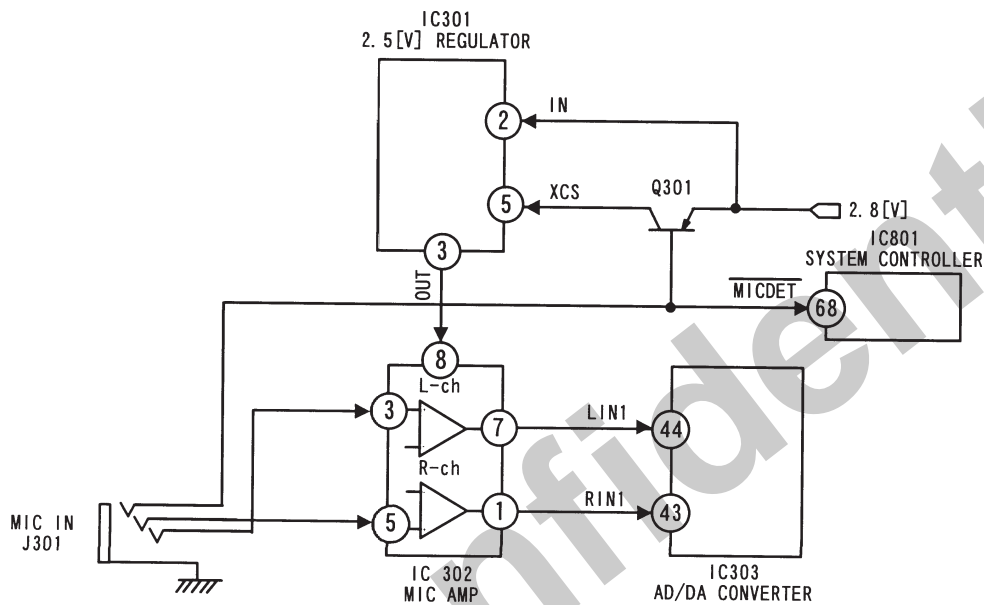


Fig. 5-6 Generation of microphone amplifier IC302 drive voltage

Fig. 5-6 shows block diagram to generate the microphone amplifier IC302 drive voltage. When microphone plug is connected to the MIC jack as shown, input to the system controller IC801 pin^{⑥⑧} [MICDET] goes to “L”. Q301 is turned “ON” by this “L” signal. Then 2.8 V is supplied to the 2.5 V regulator IC301 pin^⑤ [XCE] that starts up IC301. When IC301 starts, 2.5 V is generated by internal series regulator and is output from pin^③ [OUT] that activates the microphone amplifier IC302.

5-4. Theory When MiniDisc Recorder Is Operated On Battery

Fig. 5-7 shows the power supply circuit when MiniDisc is operated on battery.

1. Operation when MiniDisc is operated on rechargeable lithium-ion battery.

When a rechargeable lithium-ion battery is connected, battery voltage is applied to the RESET IC802 pin⑥ [VDD] via a diode inside the dual N-channel MOS FET IC808. When IC802 is started up, the MICON +B 2.9 V is generated by the step-up/step-down regulator inside IC802. IC802 outputs the generated 2.9 V from pin⑤ [VOUT] to the system controller IC801 pin⑦ [VDD]. As the system controller IC801 is started up, the system controller IC801 detects whether a rechargeable lithium-ion battery is connected or not at pin⑩ [LIMNT (LI + MNT)]. When the system controller IC801 detects that a lithium-ion battery is connected, it outputs “H” from pin⑪ [BATTON]. When this “H” signal is output, the 12 V power that is generated by the coil/motor drive IC505 is divided by the voltage-divider resistor R830/R831 to develop about 9 V that is sent to the dual N-channel MOS FET IC808 pin⑤ [NG2] so that the N-channel FET is turned on. Then the UNREG 3.7 V is output from IC808 pin⑧ [ND2].

2. Operation when MiniDisc is operated on external battery.

When external battery such as nickel-hydrogen battery is connected, battery voltage is applied to the RESET IC802 pin⑥ [VDD] via D801 to start up IC802. The RESET IC802 has the built-in power supply voltage detection circuit which maintains the VDD input voltage to 3.4 V or higher by the self step-up circuit consisting of L801, D808, C831 and the switching output of pin④ [LX]. At the same time, when IC802 is started up, the MICON +B 2.9 V is generated by the step-up/step-down regulator inside IC802. IC802 outputs the generated 2.9 V from pin⑤ [VOUT] to IC801 pin⑦ [VDD]. When the system controller IC801 is started up, the system controller IC801 detects whether external battery is connected or not at pin⑫ [AM3]. If IC801 detects that external battery is connected, it outputs “H” from pin⑬ [XAMCN]. When this “H” signal is output, the 12 V power that is generated by the coil/motor drive IC505 is divided by the voltage-divider-resistor R825/R803 to develop about 9 V that is sent to the dual N-channel MOS FET IC808 pin④ [NG1] so that the N-channel FET inside IC808 is turned on. Then the UNREG 3.0 V is output from IC808 pin① [ND1].

■ The respective voltage outputs

The power supply voltages are supplied in the same way as when MiniDisc recorder is connected to station (MZS-R5ST). Refer to section “5-3 Circuit Voltage, sub-sections 3 to 9” for more details.

◆ Technical tip ◆

The dual N-channel MOS FET IC808 has an internal diode. Because forward voltage (Vf) of this diode is above 0.7 V, it can have a case that MiniDisc cannot surely starts working when the power supply voltage is low using size AA battery or like. Therefore, D801 is installed in MiniDisc.

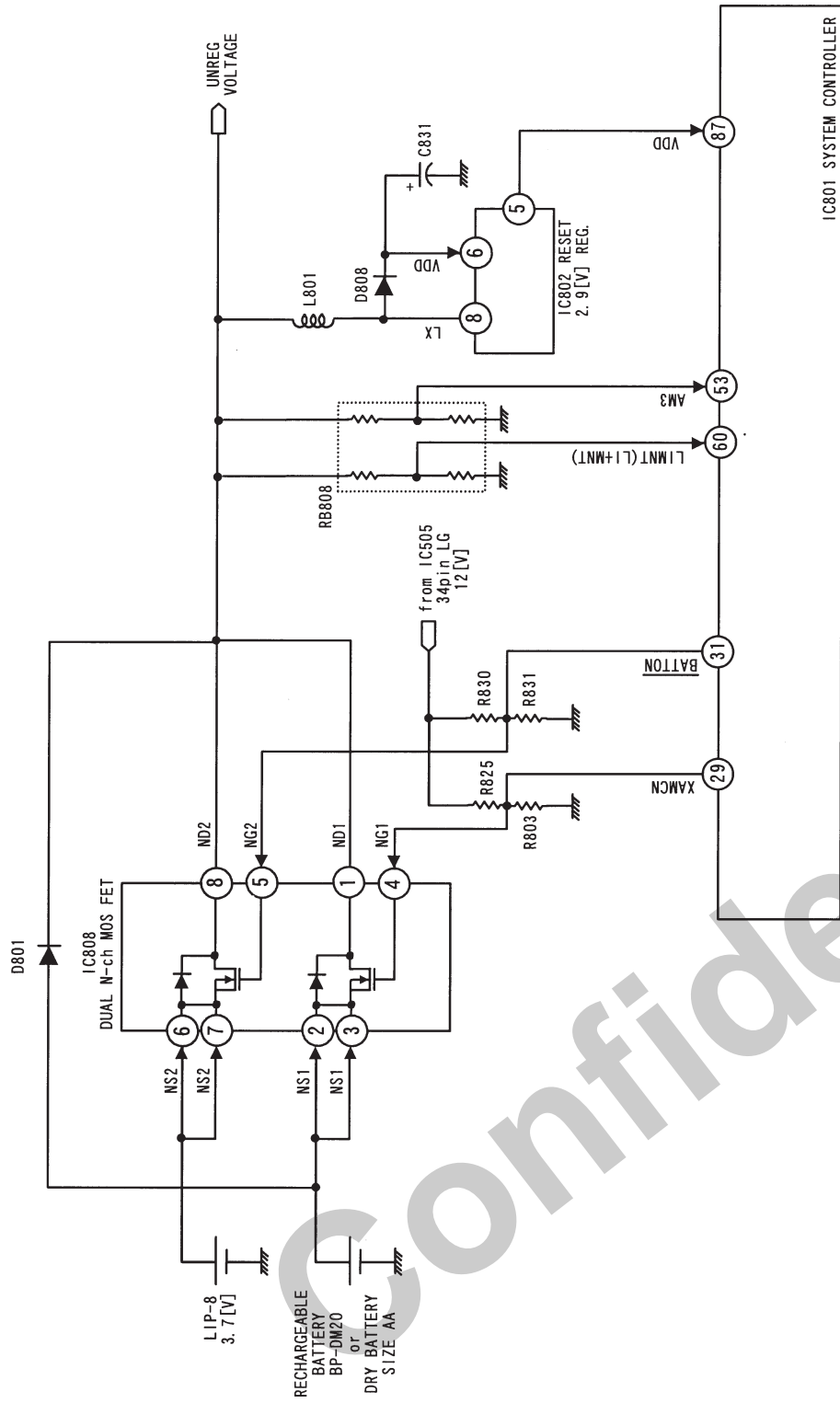


Fig. 5-7 Power supply circuit when MiniDisc recorder operates on battery

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