HA16811ANT/HA16811AMP

SLIC IC for PBX Applications

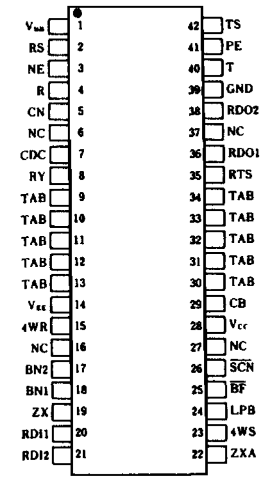
Bipolar linear process monolithic SLIC IC for PBX applications

Features

- Basic Functions: Internal battery feed control (B), loop supervision (S) and 2 W-4 W conversion
- Constant Current Feed: –24 V Supply voltage
- Internal darlington power transistor
- Ring trip detection
- Current shut-off function
- Two internal relay drivers
- Loop back function

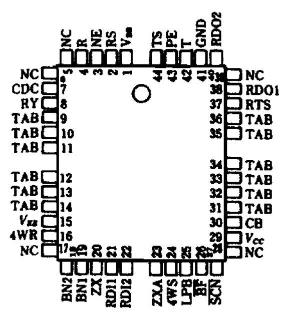
Pin Arrangement

HA16811ANT



(Top View)

HA16811AMP



(Top View)

Function

Basic Function

Current Feed Control

For PBX use, the Hitachi SLIC adapts the constant feed current method for the short distance line use. Therefore, Low power dissipation is realized by keeping the loop current typ. value at 30 mA when loop resistance R_L = 50 Ω. In addition, integration of power transistors for battery feed save mounting space on line cards.

Noise suppression circuitry insure impedance balance by improving the relative precision of the 39 Ω potential detect emitter resistor (equipped on both V_{BB} and GND sides).

Loop Supervision

The SLIC supervises subscribers' hook status (on/off) and outputs it to the $\overline{SCN}$ pin.

DC loop detection:

Detects DC loop status (open or closed) using a potential detection emitter connected to a current feed circuit and outputs it to the $\overline{SCN}$ pin through comparator

Ring Trip Detection:

See Additional Function

2 W–4 W Conversion

The SLIC provides 2-wire balanced to 4-wire signal ended conversion preventing the 4-wire input signal from returning to the 4-wire output by using external Cx, Zx, Z_{BN} and internal op-amp circuits.

Additional Function

Ring Trip Detection

With an externally connected CR filter, the Hitachi SLIC can detect the off hook of a called subscriber while ring relay sends a ringing signal. When the subscriber goes off hook, a DC current superimposed on the ringing signal flows through the telephone. This superimposed DC current is detected by the SLIC and a ring trip detection signal is sent to the system controller from the SCN pin.

Current Shut-Off Function

For protection PBX systems from the following causes, current feed is stopped by the command issued from the system controller to the $\overline{BF}$ pin.

- Subscriber loop line faults
- Emergency overload

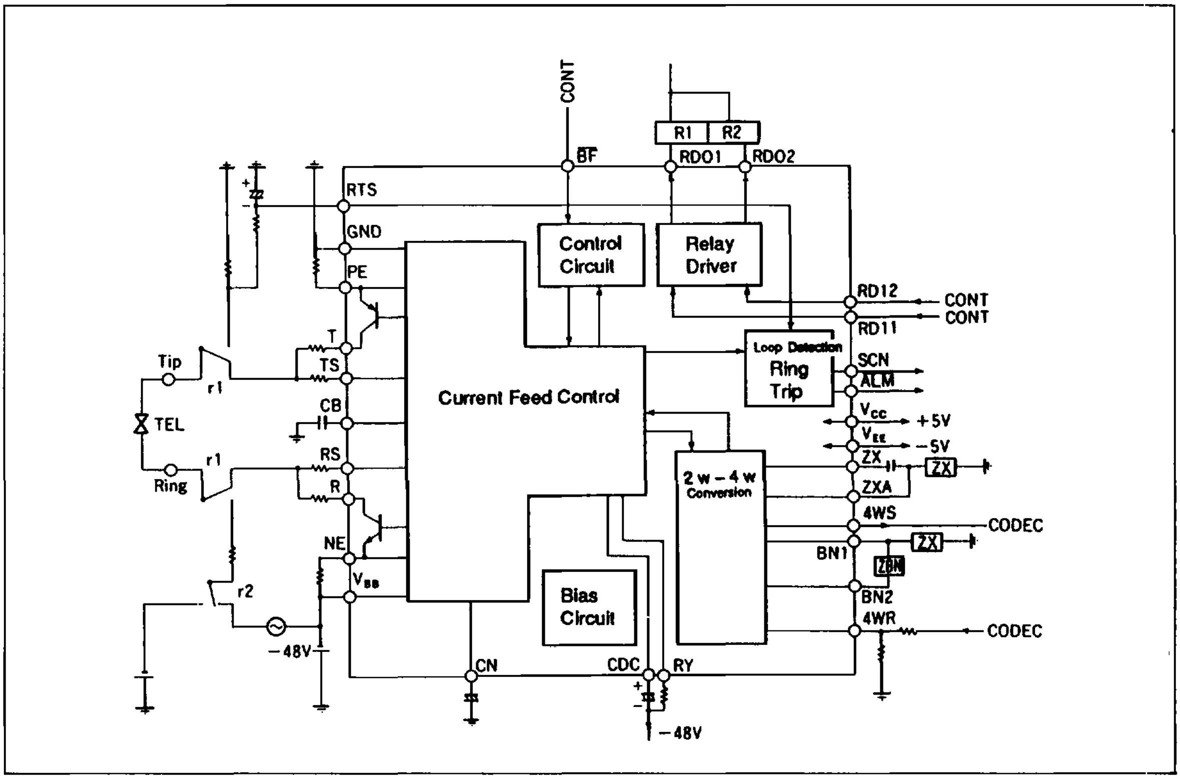
Relay Drivers

The Hitachi SLIC has two internal relay drivers which drive the relay coil directly when an enable signal is sent to the RDI1 or RDI2 pin.

Loop Back Function

Though the Hitachi SLIC usually cancels the 4-wire returning signal, loop back command at the LPB pin enable sending a 4-wire input signal as a 4-wire output signal without sending it to the subscriber loop.

Block Diagram



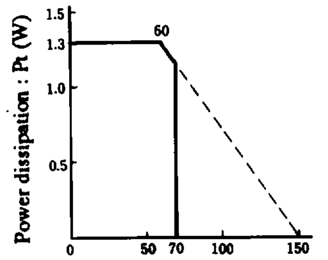
Pin Description

No. NT	No. MP	Pin Name	Functional Description
1	1	V_{BB}	–24 V voltage source input
2	2	Rs	Ring side potential detection input connected to the subscriber line through the detection resistor
3	3	NE	Ring side NPN darlington transistors' emitter potential detection input connected to V_{BB}(–24 V) through the emitter resistor
4	4	R	Ring side current feed output (sink) connected to the subscriber line through the protection resistor
5	5	CN	Connected to ground through the capacitor for power supply noise rejection
6	6	NC	No connection pin. It must not be connected to any other pin or printed circuit
7	7	C_{DC}	Low pass filter capacitor connection pin for DC feedback
8	8	RY	Connected to –24 voltage source through the resistor to make a precise differential feedback loop
9	9	TAB	Heatsink pins, connected to the heatsink area fabricated on the printed board. They must not be connected to any other pin or printed circuit.
10	10	TAB	
11	11	TAB	
12	12	TAB	
13	13,14	TAB	
14	15	V_{EE}	–5 V voltage source input
15	16	4WR	4-wire receive input which is connected to CODEC analog output through bleeder resistor for gain adjustment
16	17	NC	No connection pin. It must not be connected to any other pin or printed circuit
17	18	BN2	Received signal output pin connected to BN1 through balancing impedance Z_{BN}
18	19	BN1	Analog input of differential amp. For transhybrid rejection, it's connected to the ground through termination impedance Zx, and to BN2 through impedance Z_{BN}
19	20	ZX	DC cut capacitor and termination impedance Zx run between this terminal and ground
20	21	RDI1	TTL level digital input for relay enable signal from the system controller
21	22	RDI2	TTL level digital input for relay enable signal from the system controller
22	23	ZXA	Analog input of differential amp. For transmission, connected temination impedance Zx and DC cut capacitor
23	24	4WS	4-wire transmission output connected to CODEC
24	25	LPB	TTL level digital input for loop back enable signal from the system controller. The loop back 25mode is enable when input pin voltage is high
25	26	BF	TTL level digital input for current shut off command from the system controller. The current shut is enable when input pin voltage is high
26	27	SCN	TTL level compatible digital output which is common output of loop supervision and ring trip detection signal
27	28	NC	No connection pin. It must not be connected to any other pin or printed circuit.
28	29	V_{CC}	+5 V voltage source input
29	30	CB	Connected to the ground through the phase compensation capacitor for balance amp.
30	31	TAB	Heatsink pins, connected to the heatsink area fabricated on the print board. They must not be connected to any other pin or printed circuit
31	32	TAB	
32	33	TAB	
33	34	TAB	
34	35,36	TAB	
35	37	RTS	CR filter for ring trip detection connected to this terminal
36	38	RDO1	Analog output of relay driver connected to –24 V voltage source through a relay coil
37	39	NC	No connection pin. It must not be connected to any other pin or printed circuit
38	40	RDO2	Analog output of relay driver connected to –24 V voltage source through a relay coil
39	41	GND	Ground pin
40	42	T	Tip side current feed output (source) connected to the subscriber line through protection resistor
41	43	PE	Tip side PNP darlington transistors' emitter potential detection input connected the ground through emitter resistor.
42	44	TS	Tip side potential detection input connected to the subscriber line through the resistor for detection

Absolute Maximum Ratings (Ta = 25 °C)

Item	Symbol	Ratings	Unit	Notes
Supply Voltage	V_{BB}	–30	V	
	V_{CC}	7	V	
	V_{EE}	–7	V	
Power Dissipation	P_T	1.3	W	(Note 1)
Operating Temperature	Topr	0 to 70	°C	
Storage Temperature	Tstg	–55 to +125	°C	
Input Voltage	Vin1	–0.3 to V_{CC} + 0.3	V	Digital input pin (Note 2)
	Vin2	–5.0 to + 0.3	V	RTS pin
Input Current	I_{RS}	±117	mA	Rs pin, t ≤ 2 ms
	I_{TS}	±117	mA	Ts pin, t ≤ 2 ms
Relay Driver Output Source Current	I_{RDO}	–30	mA	RDO1, RDO2 pins

Notes 1: See derating curve
2: Indicates each BF, LPB, RDI1 and RDI2



Derating Curve

Recommended Operating Conditions

Item		Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage		V_{BB}		–26.4	–24	–21.6	V
		V_{CC}		4.75	5	5.25	V
		V_{EE}		–5.25	–5	–4.75	V
Loop Resistance		R_L	Line resistance + Terminal resistance	0		600	Ω
Signal Input Level	2W	Vi2W				3.5	dBm
	4W	Vi4W				1.5	dBm
ZX Condition	Load Impedance	R_{ZX1}	Connectable load impedance	10	—	—	kΩ
ZXA Condition	Source Impedance	R_{ZR}	Connectable source impedance	—	—	200	kΩ
BN1 Condition	Source Impedance	R_{BN1}	Connectable source impedance	—	—	50	kΩ
BN2 Condition	Load Impedance	R_{BN2}	Connectable load impedance	10	—	—	kΩ

Electrical Characteristics

Direct Current Characteristics (V_{BB} = –24 V, V_{CC} = 5 V, V_{EE} = –5 V, Ta = 25 °C)

Item		Symbol	Condition	Min	Typ	Max	Unit
Power Supply	On hook	I_{BB}	R_L = ∞	–4.5	—	—	mA
		I_{CC}		—	6.9	11.4	mA
		I_{EE}		–4.4	–2.9	—	mA
	Off hook	I_{BBL}	R_L = 50 Ω	–9.2	—	—	mA
		I_{CCL}		—	—	13.4	mA
		I_{EEL}		–4.4	—	—	mA
Power Dissipation	On hook	P_{DC}	R_L = ∞	—	—	180	mW
	Off hook	P_{DCL}	R_L = 200 Ω	—	—	850	mW
Direct Current Feed		I_{LO}	R_L = 50 Ω	26	30	34	mA
		I_{L300}	R_L = 300 Ω	26	30	34	mA
		I_{L600}	R_L = 600 Ω	20	—	—	mA
Loop Detection Resistance	Off hook	R_{LTH1}		900	—	—	Ω
	On hook	R_{LTH2}		—	—	10	kΩ
Relay Driver Output Voltage		RDV_{OH}	I_{OH} = –30 mA	–2.0	—	—	V
Ring Trip Comparator Threshold Voltage		$RTSV_{TH}$		–0.97	–0.85	–0.74	V
Input Clamp Diode		V_{FAP}	V_{BB} = –10 V	0.3	—	3	V
		V_{FAN}	I_F = 117 mA	0.3	—	3	V
		V_{FBP}		0.3	—	3	V
		V_{FBN}		0.3	—	3	V
Ground Short Protection	On	R_{GF1}	V_{BB} = –21.6 V	10	—	—	Ω
	Off	R_{GR3}	V_{BB} = –26.4 V	—	—	20	kΩ
Battery Short Protection	On	R_{BF1}	V_{BB} = –21.6 V	10	—	—	Ω
	Off	R_{BR3}	V_{BB} = –26.4 V	—	—	20	kΩ
Digital Input/Output	$\overline{BF}$	BFV_{IH}		2.0	—	—	V
		BFV_{IL}		—	—	0.8	V
		BFI_{IH}	V_{IH} = 2.0 V	–5	0	5	µA
		BFI_{IL}	V_{IL} = 0.8 V	–10	1	5	µA
	RDI1	$RD1V_{IH}$		2.0	—	—	V
		$RD1V_{IL}$		—	—	0.8	V
		$RD1I_{IH}$	V_{IH} = 2.0 V	65	100	170	µA
		$RD1I_{IL}$	V_{IL} = 0.8 V	14	40	70	µA
	RDI2	$RD2V_{IH}$		2.0	—	—	V
		$RD2V_{IL}$		—	—	0.8	V
		$RD2I_{IH}$	V_{IH} = 2.0 V	65	100	170	µA
		$RD2I_{IL}$	V_{IL} = 0.8 V	14	40	70	µA
	LPB	$LPBV_{IH}$		—	—	2.0	V
		$LPBV_{IL}$		—	—	0.8	V
		$LPBI_{IH}$	V_{IH} = 2.0 V	30	70	160	µA
		$LPBI_{IL}$	V_{IL} = 0.8 V	10	27	60	µA
	SCN	$SCNV_{OL}$	V_{CC} = 5.25 V, I_{OL} = 1.6 mA	—	—	0.4	V
		$SCNV_{OH}$	V_{CC} = 4.75 V, I_{OH} = –0.4 mA	2.4	—	—	V

Alternating Current Characteristics (V_{BB} = –24 V, V_{CC} = 5 V, V_{EE} = –5 V, Ta = 25 °C)

Item		Symbol	Test Condition	Input Level (Vrms)	Min	Typ	Max	Unit
Transmission Gain	2 w→4 w	G241	f = 1 kHz	1.16	3.55	3.85	4.15	dB
	4 w→2 w	G421	R_L = 200 Ω	0.921	1.7	2.0	2.3	dB
Attenuation Distortion	2 w→4 w	GF24	f = 3.4 kHz	1.16	–0.1	—	0.1	dB
	4 w→2 w	GF42	1 kHz R_L = 300 Ω	0.921	–0.1	—	0.1	dB
Idle Channel Noise		NI2	R_L = 200 Ω		—	—	–81.1	dBmop
		NI4			—	—	–81.1	dBmop
S/N	2 w→4 w	SN24	f = 1 kHz	1.16	53	—	—	dB
	4 w→2 w	SN42	R_L = 600 Ω	0.921	53	—	—	dB
Impedance Balance		LB2W	f = 3.4 kHz R_L = 600 Ω	0.775	40	—	—	dB
Return Loss		LM1	f = 0.3 kHz R_L = 200 Ω	1.16	20	—	—	dB
Balance Return Loss		LR	f = 3.4 kHz R_L = 600 Ω	0.921	23	—	—	dB
Idle Channel Noise on Alternating Current Induction		NI2AC	R_L = 600 Ω f = 60 Hz IAC = 6.4 mArms		—	—	–72	dBmop
Loop Back Transmission Gain	4 w→4 w	GLPB44	f = 1 kHz R_L = 200 Ω	0.775	5.7	6.0	6.3	dB
PSRR	V_{BB}→2w	LB2	f = 3.4 kHz	24.5mVrms	20	—	—	dB
	V_{CC}→2 w	LC2	R_L = 600 Ω	24.5mVrms	20	—	—	dB
	V_{EE}→2 w	LE2		24.5mVrms	20	—	—	dB

Digital Input/Output Logic

SCN Output Logic Truth Table

	Item		
$\overline{BF}$	R_L	Ground short	SCN
L	On hook	Ground/battery short	L
	R_L > Rth1	No ground/battery short	H
	Off hook	Ground/battery short	L
	R_L < Rth2	No ground/battery short	L
H	On hook	Ground/battery short	L
	R_L > Rth1	No ground/battery short	H
	Off hook	Ground/battery short	L
	R_L < Rth2	No ground/battery short	H

Loop Back Truth Table

LPB	Loop Back Mode
H	On
L	Off

Digital Input/Output Logic (cont)

Relay Driver Truth Table

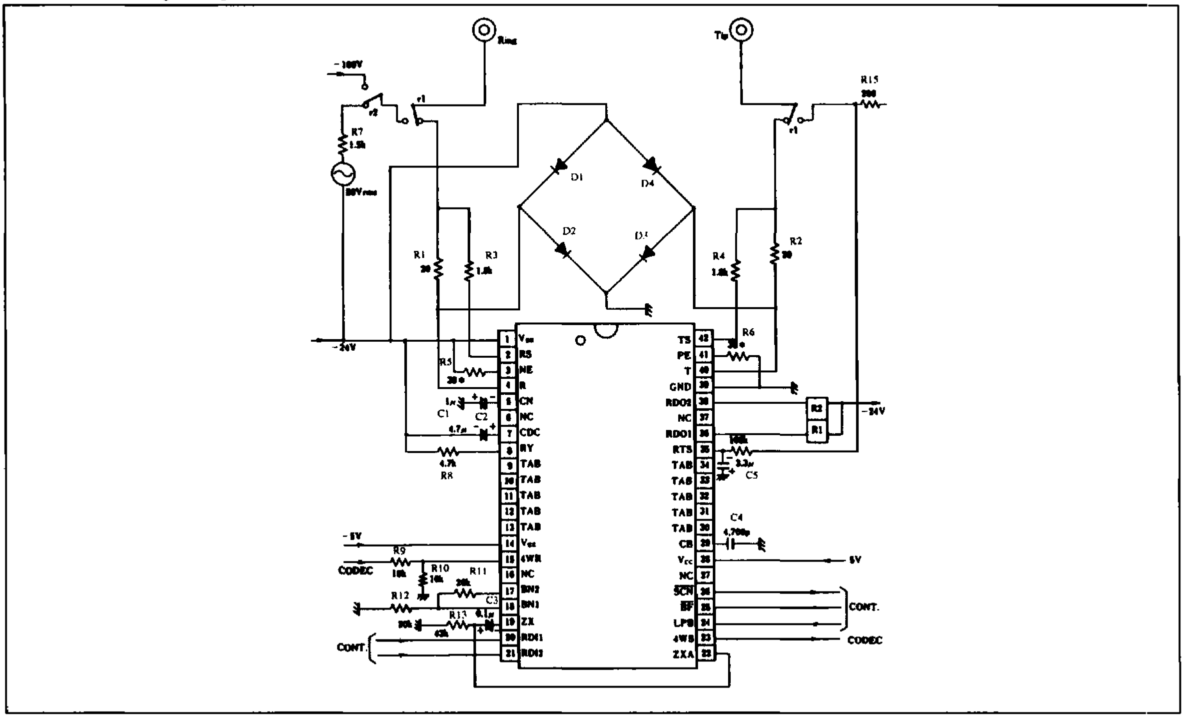
Input		Output	
RDI1	RDI2	RDO1	RDO2
H	—	H(On)	—
L	—	L(Off)	—
—	H	—	H(On)
—	L	—	L(Off)

BF Truth Table

$\overline{BF}$	Current Feed
H	Stop feeding
L	Feeding

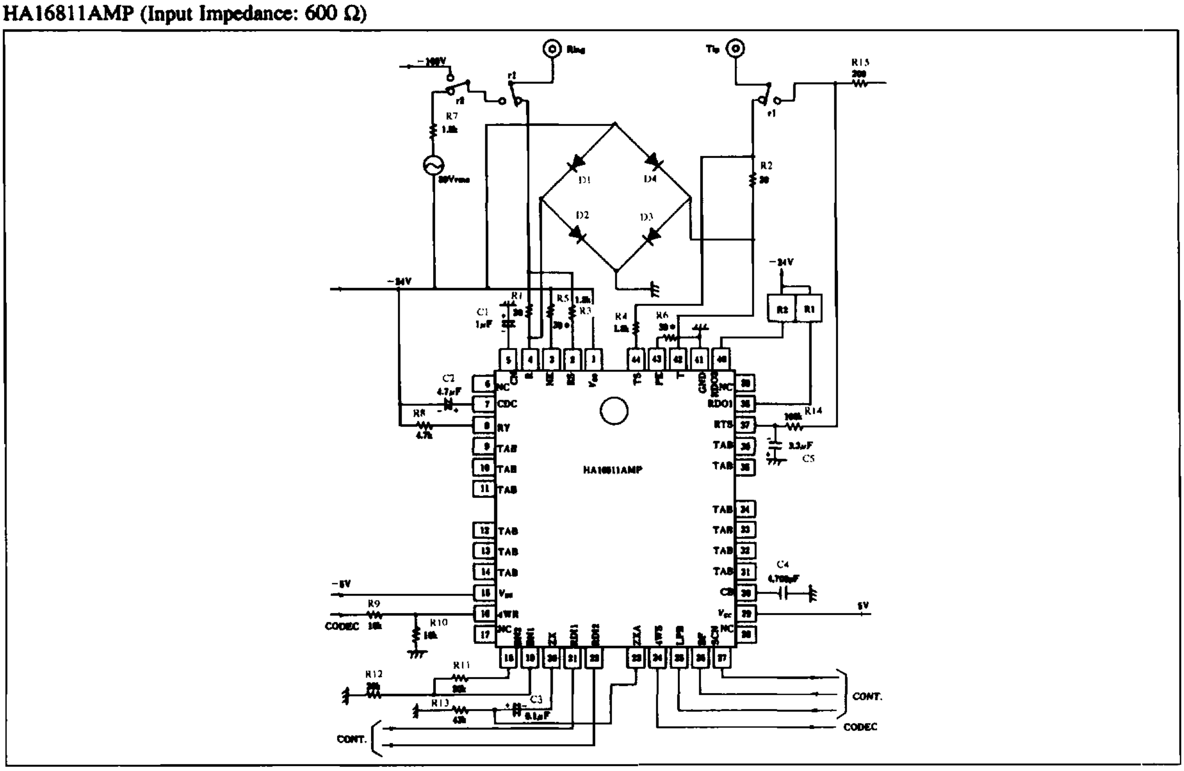
Circuit Example

HA16811ANT (Input Impedance: 600 Ω)



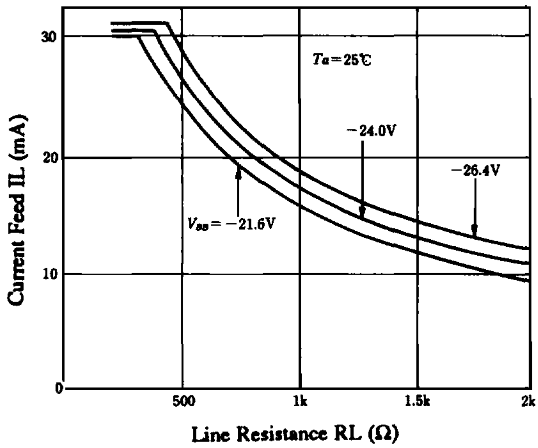
Note: Relative precision of these registers should be within ±0.1 %

HA16811AMP (Input Impedance: 600 Ω)

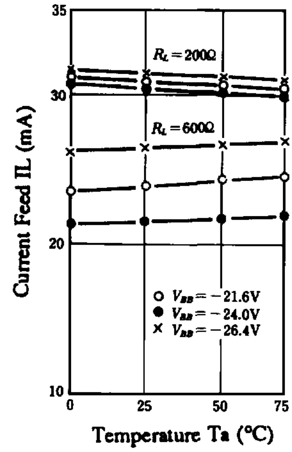


Note: Relative precision of these registers should be within ±0.1 %

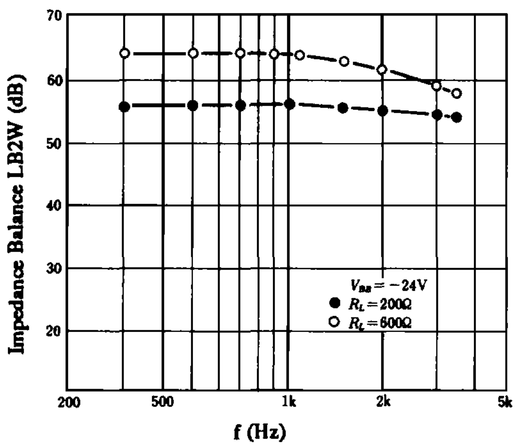
Current Feed vs. Line Resistance Characteristics



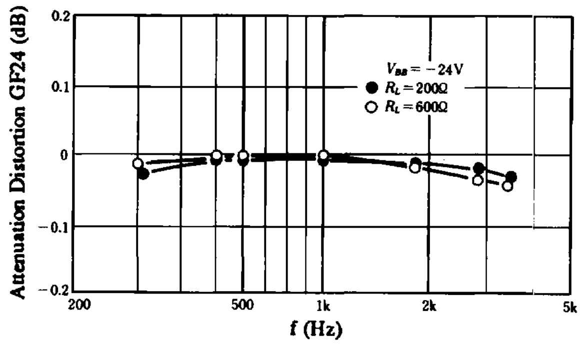
Current Feed vs. Temperature Characteristics



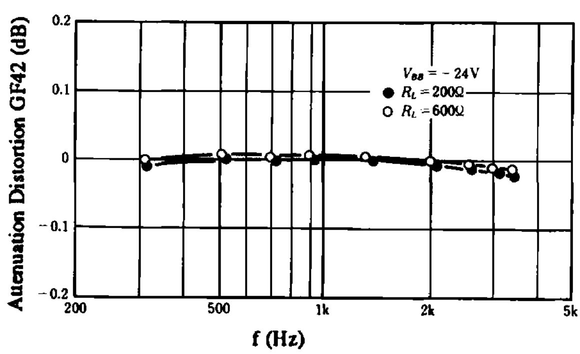
Impedance Balance vs. Frequency Characteristics



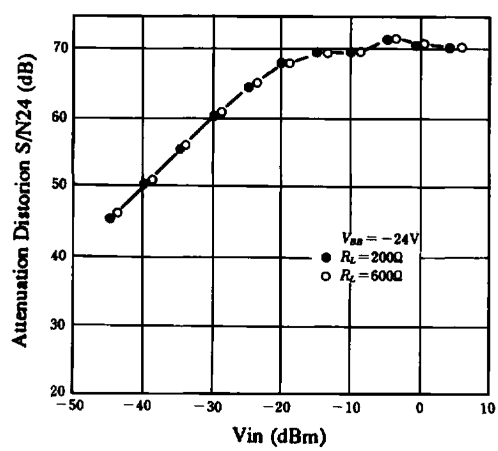
Attenuation Distortion vs. Frequency (2W → 4W) Characteristics



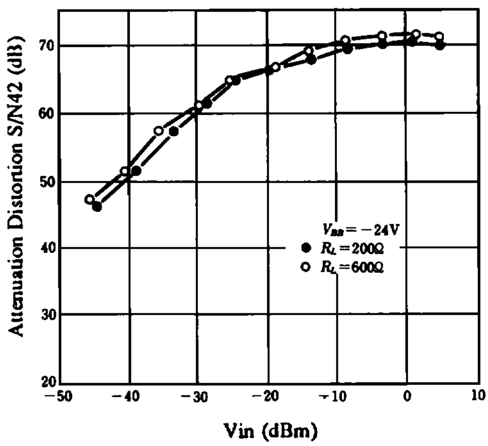
Attenuation Distortion vs. Frequency (4W → 2W) Characteristics



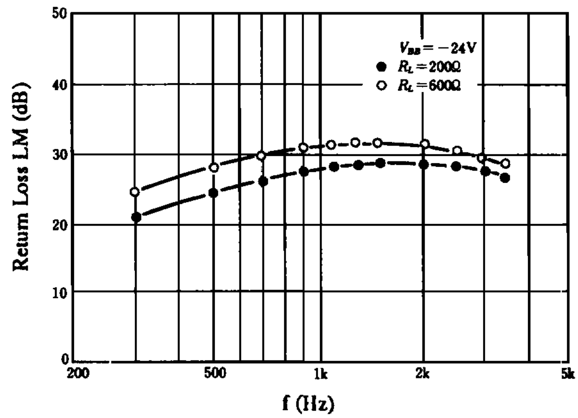
Attenuation Distortion vs. Input (4W → 2W) Characteristics



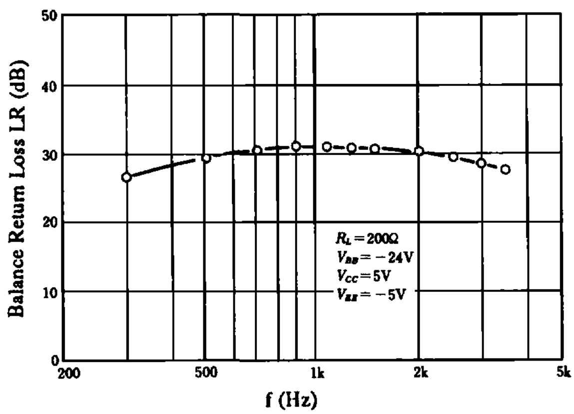
Attenuation Distortion vs. Input (2W → 4W) Characteristics



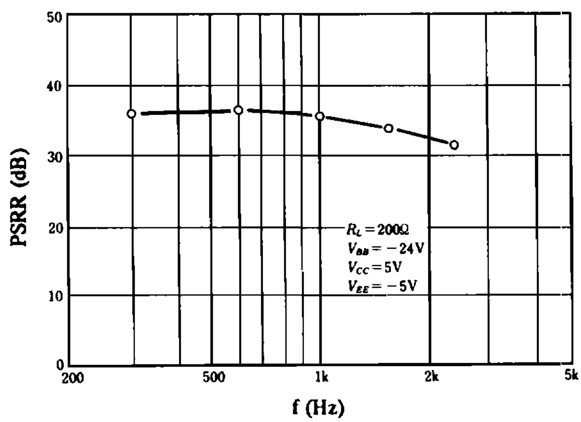
Return Loss vs. Frequency Charcteristics



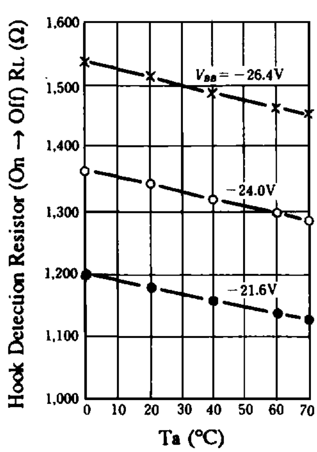
Balance Return Loss vs. Frequency Characteristics



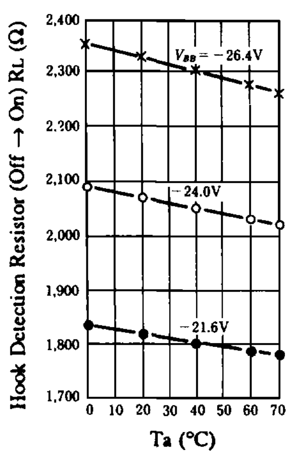
PSRR (VBB) vs Frequency Characteristics



Hook Detection Resistor (On → Off) vs. Temperature Characteristics −1



Hook Detection Resistor (Off → On) vs. Temperature Characteristics −2



External Connected Components Specification Example

Name	Spec	Accuracy	Unit	Power dissipation	Remarks	Note
R1 R2	20	5%	Ω	72 mW	For R and T pin lightning surge protection	1
R3 R4	1.8	1%	kΩ	2.1 mW	For RS and TS pin lightning surge protection	2
R5 R6	39	1%	Ω	140 mW		3
R7	1.5	3%	kΩ	2.9 W	The current during ring-tripping should be considered	4
R8	4.7	1%	kΩ	0.42 mW		5
R9 R10	10		kΩ	0.08 mW		5
R11 R12	20		kΩ	0.01 mW		5
R13	43		kΩ	0.02 mW		5
R14	100	5%	kΩ	5.3 mW		
R15	200	3%	Ω	390 mW	The current during ring-tripping should be considered	4
C1	1	20%	μF		Breakdown voltage 30V	
C2	4.7	20%	μF		15V	
C3	0.1	10%	μF		15V	6
C4	4700	10%	pF		30V	
C5	3.3	10%	μF		30V	
D1 D2 D3 D4	IF peak≥12A		A		For R and T pin lightning surge protection	1

Notes
1. R1 and R2 are protected in HA16811A from lightning surge.
   1) The resistance should be able to withstand the lightning surge current of 200V/R1 and 200V/R2 during lightning surge time ≅ 2 ms.
   2) D1-D4 also should be able to withstand the lightning source current peak.
2. The resistance should be able to withstand lightning surge current of 117mA during surge time ≅ 2 ms.
3. When high-speed, large amplitude (more than around 7 Vo-p) impulse noise is input to the tip and ring pins, peak current 150mA (max), flows through the resistor.
4. Delay time for relay switching must be considered when ring tripping. Trip delay depends on the time constant of the external filter. In this case, the estimated time is around 300 ms (max).
   Current for ring trip = (V_{BB} + VRinging) / (R7+R15)

	R7	R15
Power dissipation when tripping	5W	680 mW

5. These resistances are inserted to the pass which is only for audio signals. Therefore, the level of the audio signals should be considered in power dissipation calculations. The power dissipation in the above table is calculated according to the assumed level diagram shown below. The 4WR to BN2 gain is 0dB (BN1 is a buffer amp input pin).

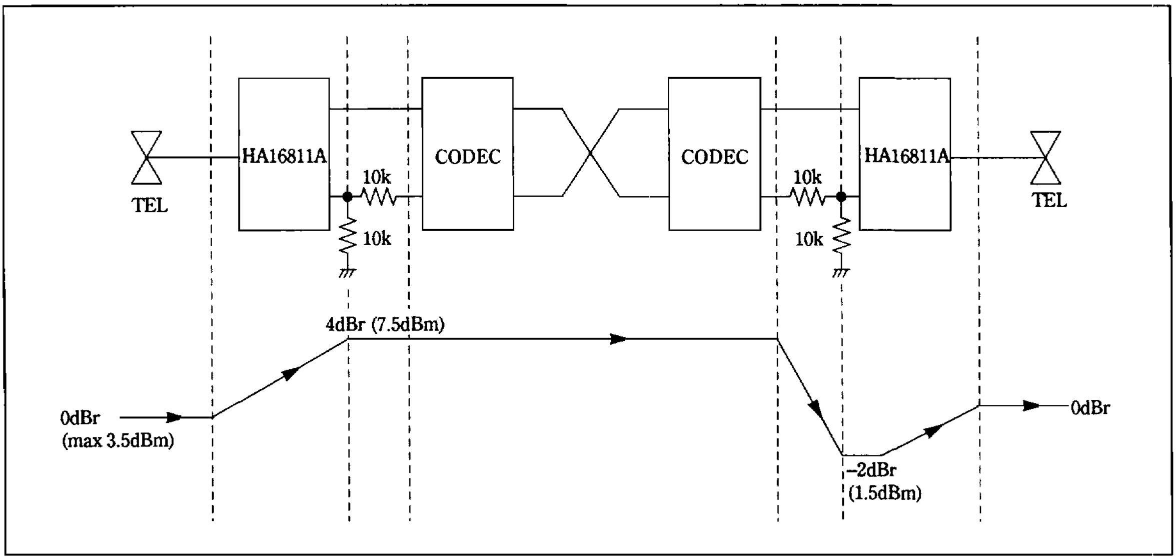


Figure 2

6. These values have a great effect on return loss and balance return loss. Therefore, capacitors whose temperature coefficients are high, such as layer-built ceramic capacitors, are not adequate for this circuit. At the ZX pin, DC 0 volts appears when the hook status is "On" and -20 volts appears when the status is "Off".