

**OPERATING & MAINTENANCE
INSTRUCTION MANUAL**

MODEL 201

AVERAGE & PEAK LIMITER



**INOVONICS
INCORPORATED**

INSTRUCTION MANUAL

MODEL 201

AVERAGE AND PEAK RESPONDING LIMITER

June 1974



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I. GENERAL INFORMATION

The Inovonics 201 is a dual-function unit which incorporates both fast-acting peak limiting and average-responding automatic gain control functions. Features, several of which are unique to the 201, include:

Fast peak limiting with accurate PEAK CEILING attenuator and variable ATTACK and RELEASE timing. Restricts program peaks to a preset ceiling value.

Independent average-responding limiter with choice of Averaging or Quasi-VU response characteristics to maintain the average program level within desired limits.

Unique "Increasing-Ratio" Compression is a continuously variable function of the input level. INPUT GAIN control with calibrated "unity gain" position permits up to 15dB of dynamic range compression.

Extremely smooth operation and low distortion afforded by exclusive open-loop gain control and ripple-cancelling circuitry.

Full display of limiting action by Gain Reduction Meter and peak-responding indicators. Optional remote-mounting meter may be located at console.

INOVONICS 201
SPECIFICATIONS

Frequency Response: $\pm 0.5\text{dB}$, 20Hz - 20kHz

Noise Level: better than 75dB below +4dBm line level

Distortion (with RIPPLE CANCEL enabled and 15dB limiting):

	50Hz - 200Hz	200Hz - 20kHz
Peak Limiter		
SLOW Release:	0.5% max.	0.25% max.
FAST Release:	1.0% max.	0.25% max.
Average Level Limiter:	0.5% max.	0.25% max.
Limiters OFF:	0.15% max., 20Hz-20kHz at +23dBm	

Limiter Timing:

Peak Limiter

 ATTACK: continuously variable between $1\mu\text{s}/\text{dB}$ -
 limiting and $1\text{ms}/\text{dB}$ -limiting

 RELEASE: continuously variable between $5\text{ms}/\text{dB}$ -
 limiting and $50\text{ms}/\text{dB}$ -limiting

Average Level Limiter

 AVG Response: $10\text{ms}/\text{dB}$ -limiting (Attack and Release)

 "VU" Response: $30\text{ms}/\text{dB}$ -limiting (Attack and Release)

Stereo Coupling: Two or more units may be interconnected
 for ganged gain reduction.

Input:

 Sensitivity: Adjusts to accommodate input levels
 between -15 and +5VU.

 Impedance: 100k, unbalanced (transformer optional)

Output: Line output feeds 600 ohm line or bridging inputs
 at +4 or +8dBm. Clipping level +24dBm.

Power Requirement: 105-130VAC (230V available), 50/60Hz,
 10 watts

Size and Weight: 1-3/4" X 19" X 6-1/2", 9 lbs.

Accessories: Remote-mounting Gain Reduction Meter; Input
 isolation transformer

II. INSTALLATION

Upon receipt of the equipment, inspect at once for shipping damage. Should any such damage be observed, notify the carrier immediately; if not, proceed as outlined below. It is suggested that the original shipping carton and materials be saved should future re-shipment become necessary.

Mounting

The Inovonics 201 is packaged to mount in a standard 19-inch equipment rack, requiring only 1-3/4 inches of panel space per channel. As the unit generates practically no heat, and itself is quite temperature insensitive, no special precautions need be taken to insure more than normal convection ventilation.

RFI

The 201 will withstand a high-RF environment, such as might be encountered in broadcasting applications. Care should be taken, however, to situate the unit away from abnormally high fields, and to provide a suitable chassis ground.

Connection

A screw-terminal barrier strip on the chassis rear apron provides connections for the Input, Output, and optional remote-mounting Gain Reduction Meter. An additional jack permits interconnection of two or more units for ganged gain reduction.

Line Considerations

As shipped, the Model 201 is calibrated for a +4dBm line level. (+4dBm = 0VU) Should operation with a +8dBm line be required, see Section V for recalibration procedures.

No output line termination is necessary, as the very low source impedance obviates any shift in characteristics, whether or not the output is terminated in 600 ohms. Should the equipment which feeds the 201 require output loading, an external 600 ohm resistor may be placed across the 201 input terminals; otherwise the input is a nominal "bridging" input.

III. OPERATION AND FUNCTIONAL DESCRIPTION

Operation

The operating controls for both the Average Level Limiter and the Peak Limiter are respectively grouped and identified. However, as terminology relating to Audio Limiters varies, a brief description of control functions and typical use situations follows.

INPUT GAIN Control

With limiter controls set to restrict average and peak program levels to appropriate values, and the INPUT GAIN control in the counterclockwise "0dB - CAL" position, the 201 functions as a unity-gain "protective" device, limiting only the levels which exceed the pre-set ceilings. By taking the INPUT GAIN control out of the calibrated position and turning it clockwise, nearly any degree of signal compression can be obtained.

AVERAGE LEVEL LIMITER Controls

RESPONSE: selects between a fast "averaging" function or a "quasi-VU" response characteristic. "VU" response operation achieves an effect similar to manual gain-riding based on VU meter indications. The maximum indication of a VU meter monitoring the Limiter output signal will correlate fairly well with the setting of the AVG. LIMIT control in this mode.

AVG. LIMIT: sets the ceiling for average program level.

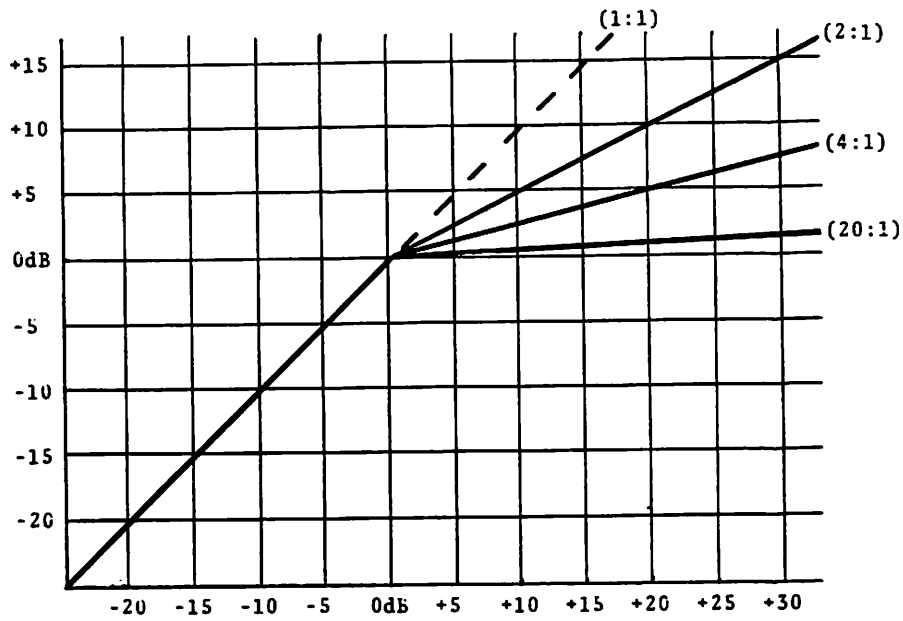
PEAK LIMITER Controls

Unlike conventional limiters operating in a closed-loop configuration, the "knee" of the Inovonics 201 Limiter curve is not abrupt (see Fig. 3-1); rather, it is a gentle transition from a linear to a limited condition. The area of increasing-ratio compression prior to the infinite ratio afforded by the optimally-flat ceiling of the Model 201, yields a smooth dynamic response and decreases the audibility of Limiter operation.

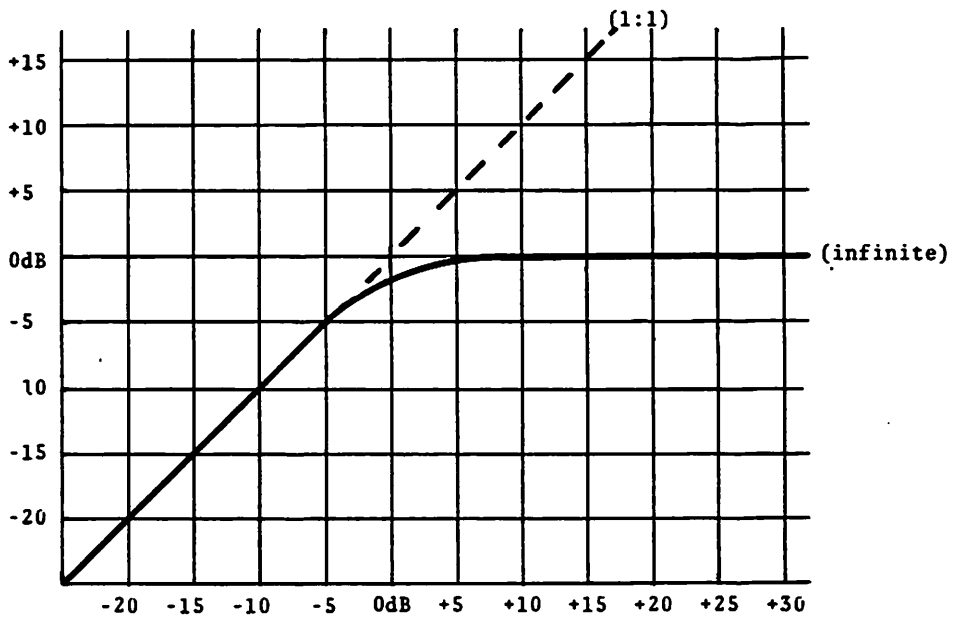
PEAK CEILING: This control sets the absolute upper limit of program peaks; even those of such short duration as to be unmeasurable by conventional VU meters. The setting of the PEAK CEILING control is dictated by the dynamic range capability of the recording or transmission system (ie. 100% modulation of an RF carrier, groovewall breakdown of a phonograph disc, or a maximum permitted distortion in the case of a tape recording.)

ATTACK: Full counterclockwise rotation of the ATTACK control gives fastest operation, assuring reduction of even the shortest-duration peaks. A slower attack may be used when very fast transients are subsequently clipped, or can otherwise be tolerated.

RELEASE: Mid-rotation of the RELEASE control is the best compromise between a fast recovery and low signal distortion. Nevertheless, the unique distortion-reducing circuits of the Model 201 permit much shorter release times than those of conventional limiters for a given value of distortion.



Conventional (closed loop) Limiter



Inovonics Model 201 Limiter

Figure 3-1
 Comparison of Conventional Limiter
 and Inovonics Model 201 Transfer Curves

RIPPLE CANCEL: In the ON position, this switch enables the distortion-reducing circuitry of the Model 201. Reduction in the generation of signal harmonics is accomplished, however, at the expense of a very slight increase in peak output level beyond the "ceiling" value. Use of this feature will have to be weighed against the small sacrifice in ceiling flatness.

GAIN REDUCTION INDICATORS:

The LINEAR lamp remains lighted as long as no gain reduction is in effect. The AVG. LEVEL REDUCTION lamp signals any operation of the Average Level Limiter circuit, and the PEAK LIMIT lamp lights whenever program peaks are reduced to the ceiling value. The Gain Reduction meter is average-responding and indicates total gain reduction in effect.

IV. CIRCUIT DESCRIPTIONS

Signal PCB

The Signal PCB contains all elements in the audio signal path. IC1 is the input amplifier, and is associated with the INPUT GAIN control. The output of this stage is routed to both the AVG. LEVEL LIMIT and PEAK CEILING attenuators, and hence to the Control PCB. The output of IC1 also feeds the Gain Reduction Module. This encapsulated circuit element provides the required gain reduction for Limiter operation as a function of a DC control current. The Module output drives Q1 and Q2, the Class AB output stage. Diodes CR11 and CR12 provide output short circuit protection.

Negative DC control voltage from the Control PCB is fed to IC2, a unity-gain buffer amplifier. This stage also provides drive for the front panel and optional remote meters. LINEARITY control, R12, converts the voltage output of IC2 to a proper current for linear gain reduction. The output of IC2 is also inverted by IC3, AC-coupled through C6, and clamped by CR5 and CR8. With the RIPPLE CANCEL feature enabled, this signal is fed out of phase with the gain controlling current to the Gain Reduction Module. The purpose of this circuit is to null the DC control signal ripple component and substantially reduce the generation of harmonic distortion, particularly at low frequencies.

Control PCB

Signals from the Peak Limiter CEILING attenuator are

fed to the Control PCB, and to emitter follower Q1. From Q1, the signal is passed to a full wave rectifier circuit consisting of IC1, IC3, and related components. This rectifier circuit converts program peaks of either polarity to negative-going signals. Transistors Q3 and Q4 are current gain stages. Capacitor C10 and resistor R27, as well as the front panel ATTACK and RELEASE controls, provide the desired Peak Limiter time constants. Diode CR13, one element of an analog "or" gate, couples the resultant DC voltage to the Signal PCB. IC5 and transistor Q5 drive the PEAK LIMIT indicator whenever the Peak Limiter is called upon to reduce circuit gain.

Similarly, signals from the AVG. LEVEL LIMIT attenuator are routed through emitter follower Q2 to a second full wave rectifier circuit, consisting of IC2, IC4, and related components. Capacitors C7 and C8, in this case, however, integrate the rectified signal to yield a negative voltage which represents the average, rather than the peak value of the input signal. CR12, the second element in the analog "or" gate, feeds this DC voltage to the Signal PCB. IC6 and Q6 drive the AVG. LEVEL REDUCTION indicator, and transistor Q7 lights the LINEAR indicator when no gain reduction is in effect.

Power Supply Regulator

The positive and negative 20-volt regulated supplies consist of a center-tapped-bridge rectifier configuration, and two similar zener voltage stabilizers utilizing compound emitter followers.

V. ALIGNMENT AND CALIBRATION

Equipment Required

AUDIO SIGNAL GENERATOR - H.P. 200CD, or equivalent
AC V.T.V.M. - H.P. 400E, or equivalent
DISTORTION ANALYZER - H.P. 330-B, or equivalent

Procedure

A. Preliminary

Set the INPUT GAIN control to the 0dB - CAL position, AVG. LIMIT and PEAK CEILING controls to OFF.

B. Power Supply Check

Apply primary power and check the positive and negative regulated supplies for 19v, \pm 1v. (The metal cans of the finned passer transistors are convenient monitor points.)

C. Gain Calibration

Feed a nominal line level signal (+4 or +8dBm) of 500Hz to the Limiter input. Adjust GAIN CAL control, R21 on the Signal PCB, for an identical reading at the Limiter output. If the Limiter is to feed a terminated input, load the unit with a 600 ohm resistor at this time.

D. Linearity Adjustment

Set the PEAK CEILING control to OVU; ATTACK to minimum, and RELEASE to maximum. While monitoring the Limiter output with a VTVM, feed a 500Hz signal to the input. Increase the oscillator amplitude slowly.

At some point the PEAK LIMIT indicator will light, and the output signal should stop increasing, even though the input signal is increased. If the output continues to increase, turn the LINEARITY control, R12 on the Signal PCB, counterclockwise. If the output increases to a point and then decreases as the input level is raised, turn the control clockwise. The proper adjustment of this control will yield a curve similar to the "infinite" curve plotted in Fig. 3-1. An optimally-flat ceiling will actually drop about 0.25dB when the input level is raised 15 to 20dB above the ceiling value.

E. Peak Limiter Calibration

With controls set as in the step above, feed the Limiter input with a 500Hz signal at a level 10dB above 0VU (oscillator output at +14 or +18dBm). Adjust the PEAK CEILING CAL control, R15 on the Control PCB, for a Limiter output of 0VU (+4 or +8dBm).

F. Meter Calibration

With the conditions as in step E above, the front panel and remote meters may be calibrated to indicate 10dB of gain reduction with R7 and R4 on the Signal PCB, respectively.

G. Distortion Null Adjustment

Set the Peak Limiter RELEASE control to FAST, and the test oscillator frequency to 50Hz. Other control settings and levels should remain as above. Monitor the Limiter output with a Total Harmonic Distortion

Meter, and with the RIPPLE CANCEL switch ON, adjust the DISTORTION NULL trimmer, R15 on the Signal PCB, for a minimum reading.

H. Average Limit Calibration

Turn the CEILING control to OFF, and set the AVG. LEVEL LIMIT control to OVU. Feeding the Limiter input with a 500Hz signal 10dB above OVU, adjust the AVG. LIMIT CAL control, R16 on the Control PCB, for a OVU output reading.

This completes calibration of the Model 201.

SCHEMATIC REF. NO.	PART NUMBER	DESCRIPTION	MFG.	MANUFACTURER PART NUMBER
	123800	<u>CONTROL PCB</u>		
C 1,2	0901	Capacitor, 5 uF, 25 V	Sprague	TE 1202
C 3,4,5,6	0801	" 10 pF, Mica	Elmenco	DM15-100J
C 7	0870	" 0.47 uF, 200 V	Sprague	225P47492
C 8	1055	" 1.5 uF, 35 V	Kemet	T310B475K035
C 9	0810	" 100 pF, Mica	Elmenco	DM15-101J
C 10	1050	" 4.7 uF, 35 V	Kemet	T310B155K035
C 11,12	0803	" 22 pF, Mica	Elmenco	DM15-220J
CR 1-18	1100	Diode, 1N4009		
IC 1-6	1300	Integrated Circuit, Type 748	Signetics	N5748V
Q 1,2,4,7	1204	Transistor, 2N3567		
Q 3,5,6	1205	" 2N3645		

(parts list 1)

SCHEMATIC REF. NO.	PART NUMBER	DESCRIPTION	MFG.	MANUFACTURER PART NUMBER
R 1,2, 17	0161	Resistor, $\frac{1}{4}$ W, 10% 1 k	Allen-Brad.	
R 3,4	0168	" " " 3.9 k	"	
R 5-10	0089	" " 5% 20 k	"	
R 11,12	0083	" " " 10 k	"	
R 13	0177	" " 10% 22 k	"	
R 14	0181	" " " 47 k	"	
R 15	0563	Resistor, variable, 100 k	Helipot	91AR100K
R 16	0564	" " 200 k	"	91AR200K
R 18	0197	Resistor $\frac{1}{4}$ W, 10% 1 Meg	Allen-Brad.	
R 19	0180	" " " 39 k	"	
R 20-23	0176	" " " 18 k	"	
R 24	0375	" $\frac{1}{2}$ W, " 180 ohm	"	
R 25	0379	" " " 390 ohm	"	
R 26	0372	" " " 100 ohm	"	
R 27	0173	" $\frac{1}{4}$ W " 10 k	"	

(parts list 2)

SCHEMATIC REF. NO.	PART NUMBER	DESCRIPTION	MFG.	MANUFACTURER PART NUMBER
	123 300	<u>SIGNAL PCB</u>		
C 1	0870	Capacitor, 0.47 uF, 200 V	Sprague	225P47492
C 2,5	0803	" 22 pF, mica	Elmenco	DM15-220J
C 3	0810	" 100 pF, Mica	Elmenco	DM15-101J
C 4	0801	" 10 pF, Mica	Elmenco	DM15-100J
C 6	0901	" 5 uF, 25 V	Sprague	TE 1202
C 7	0906	" 100 uF, 3. V	Sprague	TE 1059.5
CR 1-5, 7-12	1100	Diode, 1N4009		
CR 6	1106	" 1N270		
IC 1,3	1300	Integrated Circuit, Type 748	Signetics	5748V
IC 2	1305	" " MC 1456 CG	Motorola	
Q 1	1204	Transistor, 2N3567		
Q 2	1205	" 2N3645		
	109100C	Gain Control Module		

(parts list 3)

SCHEMATIC REF. NO.	PART NUMBER	DESCRIPTION	MFG.	MANUFACTURER PART NUMBER
		<u>CHASSIS</u>		
C 1,2	0910	Capacitor, 500 uF, 50 V	Sprague	TVA 1315
I 1	2002	Indicator, Amber	Dialco	507-3918-1433-60
I 2	2001	" , Red	Dialco	507-3918-1431-60
I 3	2010	" , Green	Dialco	507-3918-1432-60
	1711	Sockets for I 1-3	Eldema	Q-082-2K
	2003	Retainer " "	Eldema	Q-081-905
	2004	Rubber Washer "	Eldema	Q-145-008
M 1	2801	Meter		
R 1	0609	Resistor, variable, 10 k	Allen-Brad.	JA1N056S103UC
R 2	0601	" " 100 k with switch	"	JS1N056S104AA
R 3	0082	Resistor, 1/4W, 5%, 9.1 k		
R 4	0212	" " " 1.6 k		
R 5,7,12,14,19	0051	" " " 430 ohm		
R 6	0062	" " " 1.2 k		
R 8	0063	" " " 1.3 k		

(parts list 4)

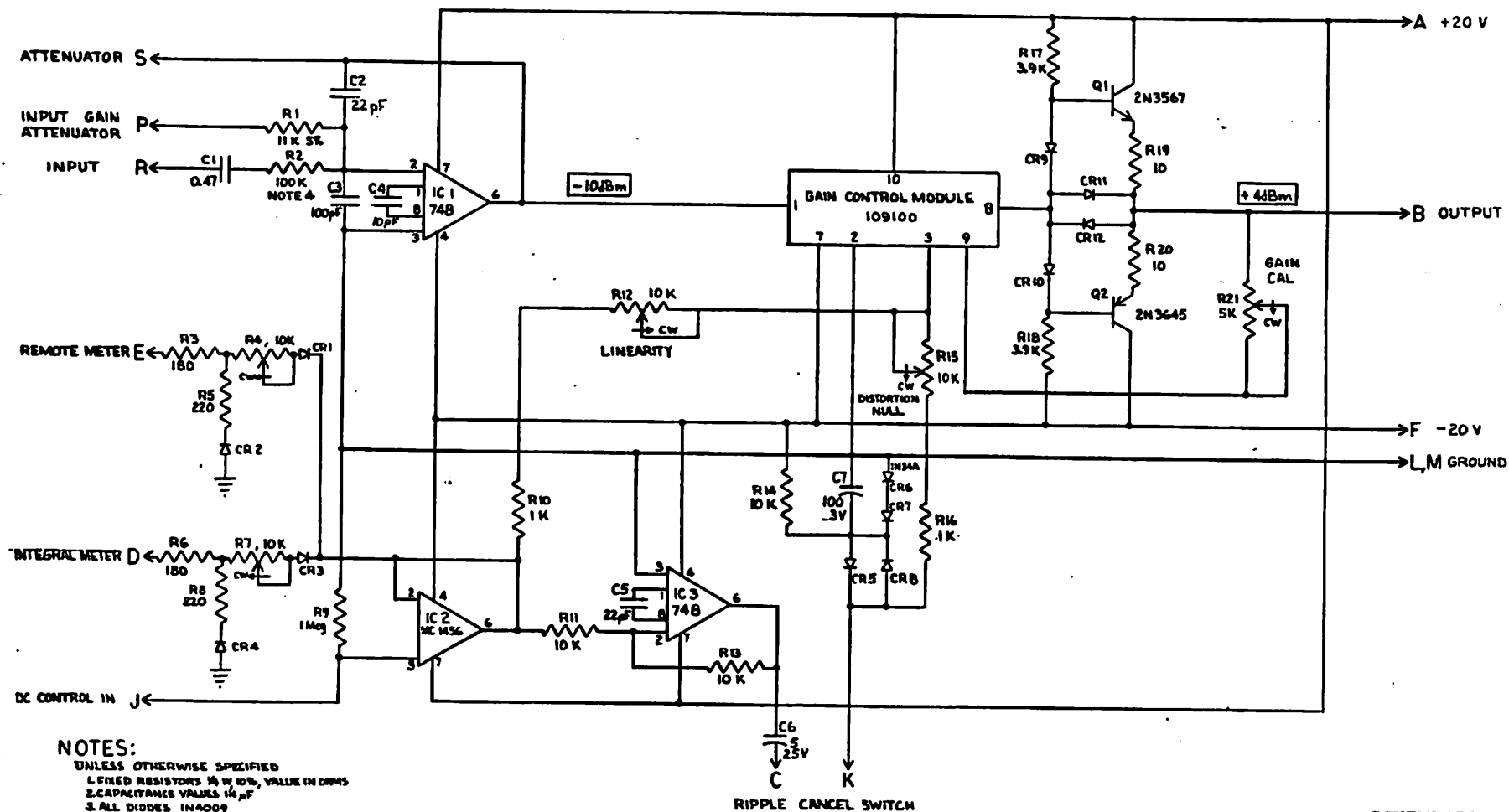
SCHEMATIC REF. NO.	PART NUMBER	DESCRIPTION	MFG.	MANUFACTURER PART NUMBER
R 1	0084	Resistor, $\frac{1}{2}$ W, 5% 11 k	Allen-Bradley	
R 2	0185	" " 10% 100 k	"	
R 3,9	0152	" " " 180 ohm	"	
R 4,7,12,15	0559	Resistor, variable 10 k	Helipot	91AR10K
R 5,8	0153	Resistor, $\frac{1}{2}$ W, 10% 220 ohm	Allen-Bradley	
R 6	0197	" " " 1 Meg	"	
R 10,16	0161	" " " 1 k	"	
R 11,13,14	0173	" " " 10 k	"	
R 17,18	0168	" " " 3.9 k	"	
R 19,20	0137	" " " 10 ohm	"	
R 21	0558	Resistor, variable 5 k	Helipot	91AR5K

(parts list 4)

SCHEMATIC REF. NO.	PART NUMBER	DESCRIPTION	MFG.	MANUFACTURER PART NUMBER
R 9	0054	Resistor, $\frac{1}{4}$ W, 5% 560 ohm		
R 10	0052	" " " 470 ohm		
R 11,20	0058	" " " 820 ohm		
R 13	0044	" " " 220 ohm		
R 15,17	0035	" " " 82 ohm		
R 16,18	0048	" " " 330 ohm		
R 21	0613	Resistor, variable, 100 k	Allen-Brad	WA2G056S104UA
R 22	0612	" " 1 k	"	WA2G056S102UA
S 2	117500	Switch Assy., PEAK CEILING Attenuator		
S 3,4	1804	Switch, SPST Miniature Toggle	C & K	7101
S 5	1802	Switch, SPST Toggle	A-H	20994LH
T 1	109000	Output Transformer		
T 2	1502	Input Transformer (optional)	UTC	0-37
	1503	Shield for T 2	UTC	0-17
T 3	1501	Power Transformer	Triad	F-90x
	2500	Knob, $\frac{1}{2}$ " Round	Raytheon	50-1-1G
	2502	" .7", Skirted	Raytheon	70-3-2G

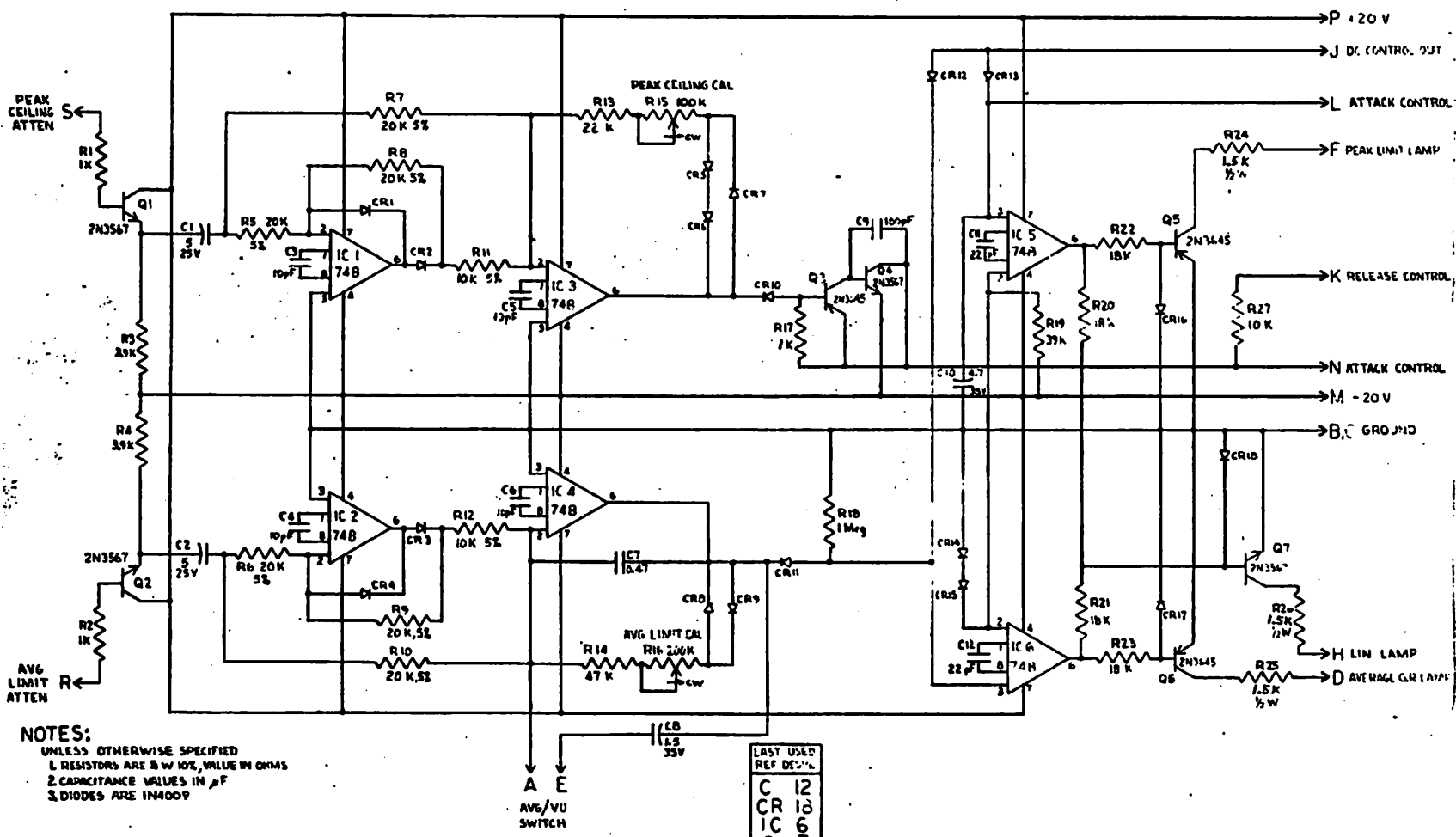
(parts list 5)

LAST USED	REF DESIG
C	7
CR	12
IC	3
Q	2
R	21

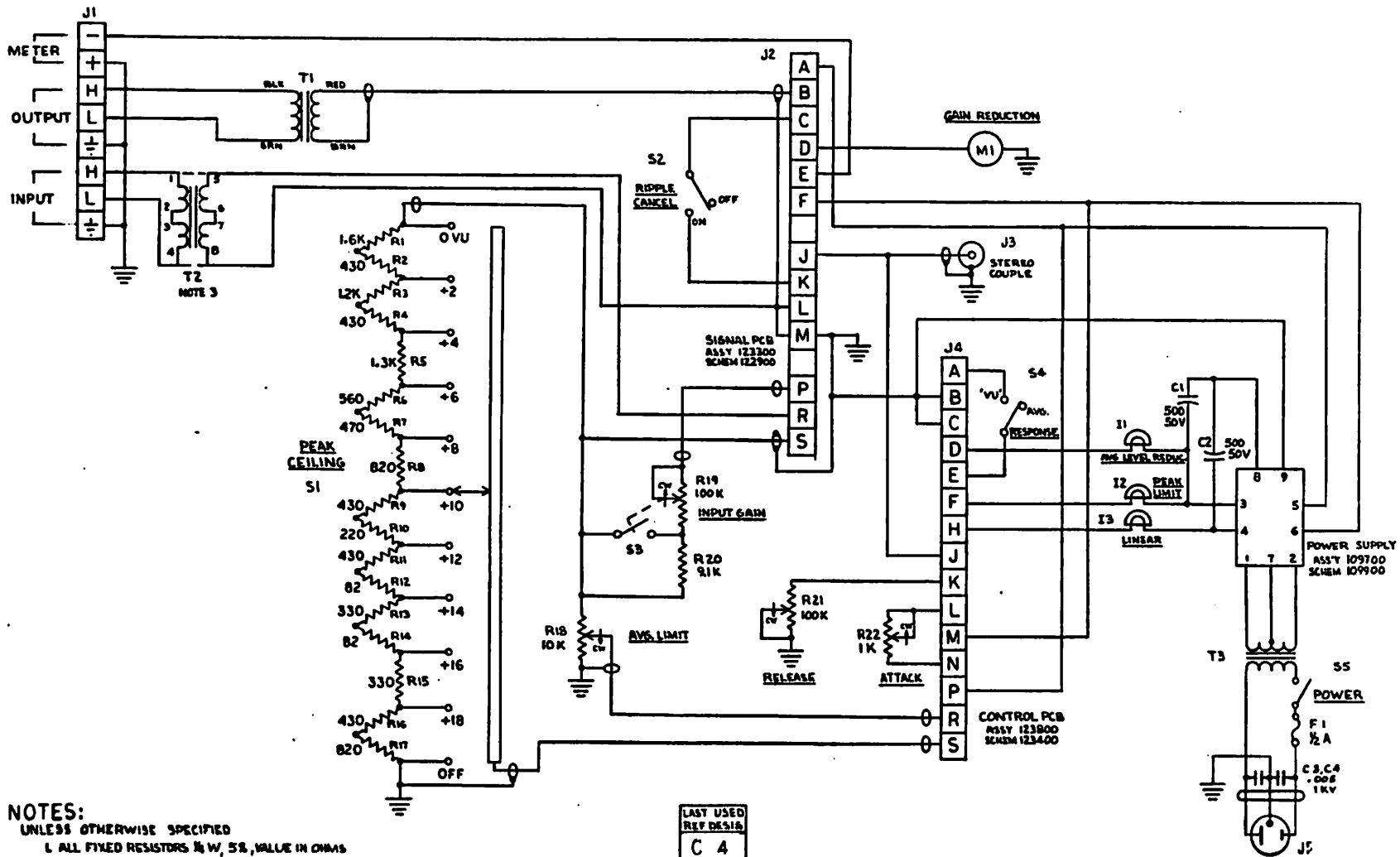


NOTES:
 1. UNLESS OTHERWISE SPECIFIED
 2. CAPACITANCE VALUES IN μ F
 3. ALL DIMES IN 4009
 4. 39K WHEN INPUT TRANSFORMER USED

SCHEMATIC, A/N 123300
 MODEL 201 - SIGNAL PCB



SCHEMATIC, A/N 123800
 MODEL 201 - CONTROL PCB



NOTES:
 UNLESS OTHERWISE SPECIFIED
 1 ALL FIXED RESISTORS 1/4 W, 5%, VALUE IN OHMS
 2 CAPACITANCE VALUES IN μ F
 3 DASHES SHOW CONNECTIONS WHEN OPTIONAL INPUT TRANSFORMER OMITTED

LAST USED REF DESIG	
C	4
F	1
J	5
M	1
R	22
S	5
T	3

INOVONICS WARRANTY

Inovonics, Inc. products are warranted to be free from defects in material and workmanship. Any discrepancies noted within 90 days of the date of purchase will be repaired free of charge. Additionally, parts for repairs required between 90 days and one year from the date of purchase will be supplied free of charge, with installation billed at normal rates. It will be the responsibility of the purchaser to return equipment for warranty service to the dealer from whom it was originally purchased unless prior arrangement is made with the dealer to inspect or repair at the user's location.

This warranty is subject to the following conditions:

1. Warranty card supplied with the equipment must be completed and returned to the factory within 10 days of purchase.
2. Warranty is void if unauthorized attempts at repair or modification have been made, or if serial identification has been defaced, removed, or altered.
3. Warranty does not apply to damage caused by misuse, abuse, or accident.
4. Warranty valid only to original purchaser.

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