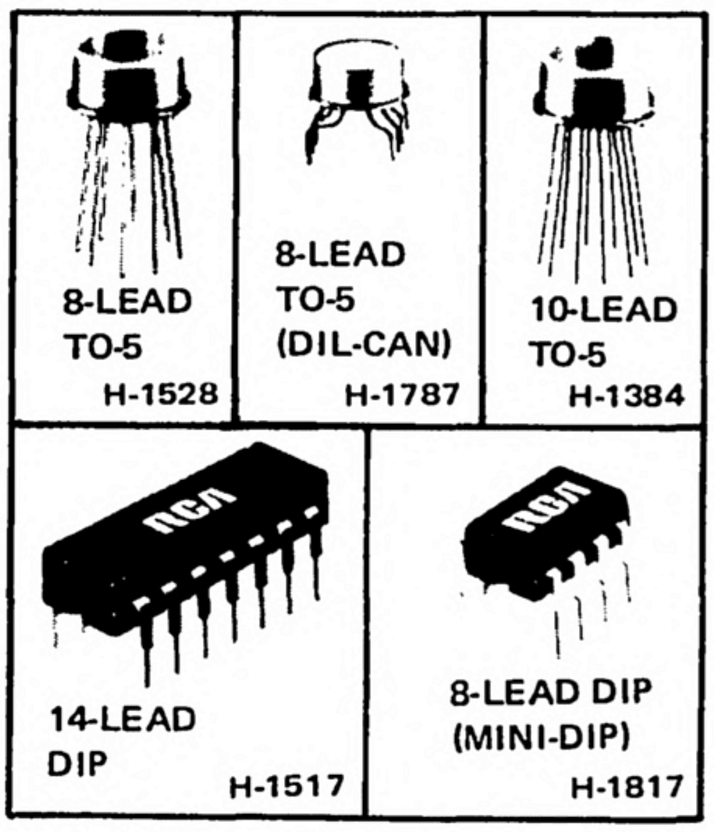
RCA
Solid State
Division

Linear Integrated Circuits

Monolithic Silicon

CA741, CA741C, CA747, CA747C, CA748, CA748C, CA1458, CA1558 Types



Operational Amplifiers

High-Gain Single and Dual Operational Amplifiers
For Military, Industrial and Commercial Applications

Applications:

- **Comparator**
- **DC amplifier**
- **Integrator or differentiator**
- **Multivibrator**
- **Narrow-band or band-pass filter**
- **Summing amplifier**

Features:

- **Input bias current (all types): 500 nA max.**
- **Input offset current (all types): 200 nA max.**

RCA-CA1458, CA1558 (dual types); CA741C, CA741 (single-types); CA747C, CA747 (dual types); and CA748C, CA748 (single types) are general-purpose, high-gain operational amplifiers for use in military, industrial, and commercial applications.

These monolithic silicon integrated-circuit devices provide output short-circuit protection and latch-free operation. These types also feature wide common-mode and differential-mode signal ranges and have low-offset voltage nulling capability when used with an appropriately valued potentiometer. A 5-megohm potentiometer is used for offset nulling types. CA748C, CA748 (See Fig. 9); a 10-kilohm potentiometer is used for offset nulling types CA741C, CA741, CA747CE, CA747E (See Fig. 8); and types CA1458, CA1558, CA747CT, CA747T have no specific terminals for offset nulling. Each type consists of a differential-input amplifier that effectively drives a gain and level-shifting stage having a complementary emitter-follower output.

This operational amplifier line also offers the circuit designer the option of operation with internal or external phase compensation. Types CA748C and CA748, which are externally phase compensated (terminals 1 and 8) permit a choice of operation for improved bandwidth and slew-rate capabilities. Unity gain with externa. phase compensation can be obtained with a single 30-pF capacitor. All the other types are internally phase-compensated.

RCA's manufacturing process makes it possible to produce IC operational amplifiers with low-burst ("popcorn") noise characteristics. Type CA6741, a low-noise version of the CA741, gives limit specifications for burst noise in the data bulletin, File No. 530. Contact your RCA Sales Representative for information pertinent to other operational amplifier types that meet low-burst noise specifications.

ORDERING INFORMATION

When ordering any of these types, it is important that the appropriate suffix letter for the package required be affixed to the type number. For example: If a CA1458 in a TO-5 package is desired, order CA1458T.

RCA Type No.	No. of Ampl.	Phase Comp.	Offset Voltage Null	Min. A_{OL}	Max. V_{IO} (mV)	Operating-Temperature Range (°C)	Package Type and Suffix Letter						
							TO-5			Plastic		Chip	Beam-Lead
							8L	10L	DIL-CAN	8L	14L		
CA1458	dual	int.	no	20k	6	0 to +70	T		S	E		H	
CA1558	dual	int.	no	50k	5	–55 to +125	T		S				
CA741C	single	int.	yes	20k	6	0 to +70	T		S	E		H	
CA741	single	int.	yes	50k	5	–55 to +125	T		S				L
CA747C	dual	int.	yes*	20k	6	0 to +70		T			E	H	
CA747	dual	int.	yes*	50k	5	–55 to +125		T			E		
CA748C	single	ext.	yes	20k	6	0 to +70	T		S	E		H	
CA748	single	ext.	yes	50k	5	–55 to +125	T		S				

*In the 14-lead dual-in-line plastic package only.

ELECTRICAL CHARACTERISTICS

For Equipment Design

Characteristics	Symbols	Test Conditions		LIMITS						Units
		Supply Volts: $V^+ = 15, V^- = -15$		CA741C CA747C* CA748C* CA1458			CA741 CA747* CA748* CA1558			
			Ambient Temperature (T_A)	Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage	V_{IO}	$R_S \leq 10$ kΩ	25°C	–	2	6	–	1	5	mV
			0 to 70°C	–	–	7.5	–	–	–	
			–55 to +125°C	–	–	–	–	1	6	
Input Offset Current	I_{IO}		25°C	–	20	200	–	20	200	nA
			–55°C	–	–	–	–	85	500	
			+125°C	–	–	–	–	7	200	
			0 to 70°C	–	–	300	–	–	–	
Input Bias Current	I_{IB}		25°C	–	80	500	–	80	500	nA
			–55°C	–	–	–	–	300	1500	
			+125°C	–	–	–	–	30	500	
			0 to 70°C	–	–	800	–	–	–	
Input Resistance	R_I			0.3	2	–	0.3	2	–	MΩ
Open-Loop Differential Voltage Gain	A_{OL}	$R_L \geq 2$ kΩ $V_O = \pm 10$ V	25°C	20,000	200,000	–	50,000	200,000	–	
			0 to 70°C	15,000	–	–	–	–	–	
			–55 to +125°C	–	–	–	25,000	–	–	
Common-Mode Input Voltage Range	V_{ICR}		25°C	±12	±13	–	–	–	–	V
			–55 to +125°C	–	–	–	±12	±13	–	
Common-Mode Rejection Ratio	CMRR	$R_S \leq 10$ kΩ	25°C	70	90	–	–	–	–	dB
			–55 to +125°C	--	–	–	70	90	–	
Supply Voltage Rejection Ratio	V_{RR}	$R_S \leq 10$ kΩ	25°C	–	30	150	–	–	–	μV/V
			–55 to +125°C	–	–	–	–	30	150	
Output Voltage Swing	$V_{O(P-P)}$	$R_L \geq 10$ kΩ	25°C	±12	±14	–	–	–	–	V
			–55 to +125°C	–	–	–	±12	±14	–	
		$R_L \geq 2$ kΩ	25°C	±10	±13	–	–	–	–	
			0 to 70°C	±10	±13	–	–	–	–	
			–55 to +125°C	–	–	–	±10	±13		
Supply Current			25°C	–	1.7	2.8	–	1.7	2.8	mA
			–55°C	–	–	–	–	2	3.3	
			+125°C	–	–	–	–	1.5	2.5	
Device Dissipation	P_D		25°C	–	50	85	–	50	85	mW
			–55°C	–	–	–	–	60	100	
			+125°C	–	–	–	–	45	75	

*Values apply for each section of the dual amplifiers.

ELECTRICAL CHARACTERISTICS

Typical Values Intended Only for Design Guidance

Characteristics	Symbols	Test Conditions Supply Volts: $V^+ = 15$, $V^- = -15$	LIMITS CA741C CA747C* CA748C* CA1458	LIMITS CA741 CA747* CA748* CA1558	Units
Input Capacitance	C_I		1.4	1.4	pF
Offset Voltage Adjustment Range			±15	±15	mV
Output Resistance	R_O		75	75	Ω
Output Short-Circuit Current			25	25	mA
Transient Response Risetime	t_r	Unity Gain V_I = 20 mV R_L = 2 kΩ $C_L \leq$ 100 pF	0.3	0.3	μs
Overshoot			5.0	5.0	%
Slew Rate: Closed Loop	SR	$R_L \geq$ 2 kΩ	0.5	0.5	V/μs
Open Loop▲			40	40	

▲Open-loop slew rate applies only for types CA748C and CA748.

*Values apply for each section of the dual amplifiers.

MAXIMUM RATINGS, Absolute-Maximum Values at T_A = 25°C

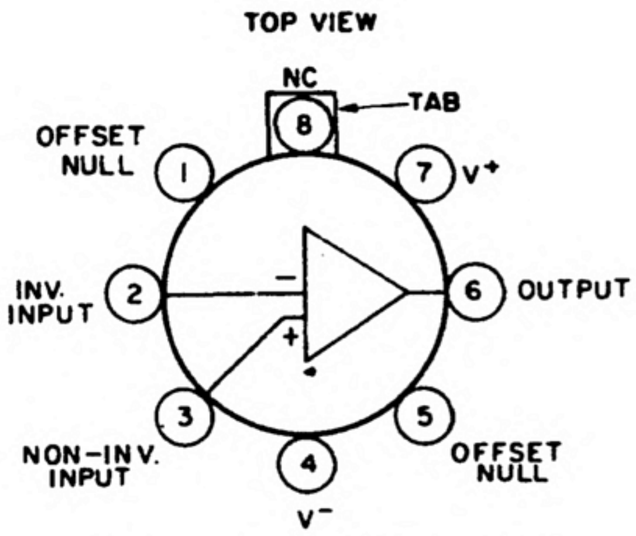
DC Supply Voltage (between V^+ and V^- terminals):
- CA741C, CA747C▲, CA748C, CA1458▲ . . . . . 36 V
- CA741, CA747▲, CA748, CA1558▲ . . . . . 44 V

Differential Input Voltage . . . . . ±30 V
DC Input Voltage* . . . . . ±15 V
Output Short-Circuit Duration . . . . . Indefinite
Device Dissipation:
- Up to 70°C (CA741C, CA748C) . . . . . 500 mW
- Up to 75°C (CA741, CA748) . . . . . 500 mW
- Up to 30°C (CA747) . . . . . 800 mW
- Up to 25°C (CA747C) . . . . . 800 mW
- Up to 30°C (CA1558) . . . . . 680 mW
- Up to 25°C (CA1458) . . . . . 680 mW

For Temperatures Indicated Above . . . . . Derate linearly 6.67 mW/°C
Voltage between Offset Null and V^- (CA741C, CA741, CA747CE) . . . . . ±0.5 V
Ambient Temperature Range:
- Operating – CA741, CA747E, CA748, CA1558 . . . . . −55 to +125 °C
- CA741C, CA747C, CA748C, CA1458 . . . . . 0 to +70 °C
- Storage . . . . . −65 to +150 °C

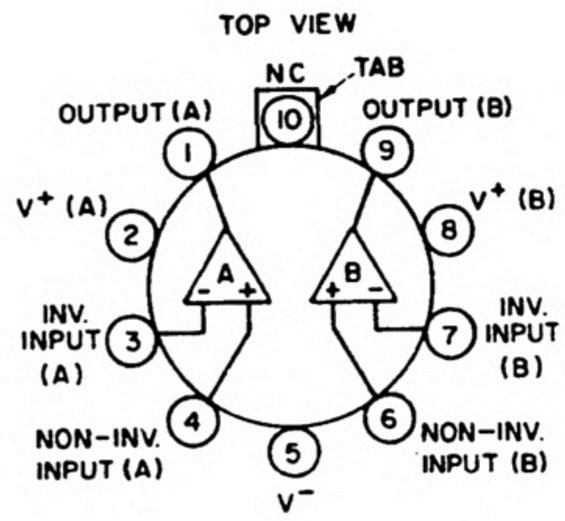
Lead Temperature (During Soldering):
- At distance 1/16±1/32 inch (1.59±0.79 mm) from case for 10 seconds max. . . . . 265°C

▲Voltage values apply for each of the dual operational amplifiers.

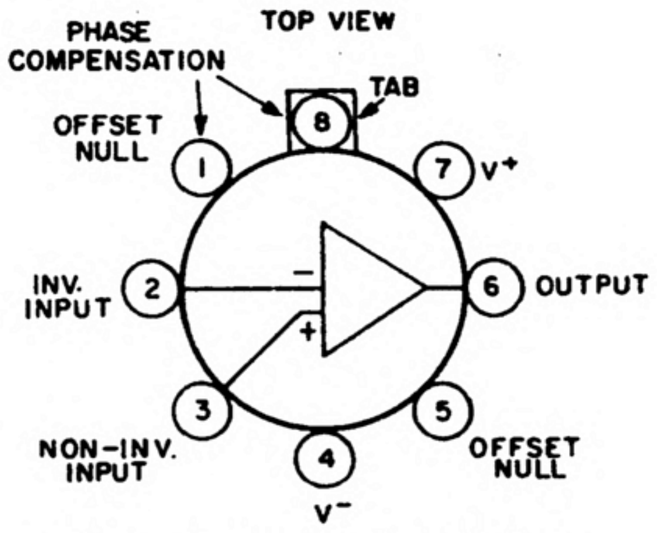


NOTE: PIN 4 IS CONNECTED TO CASE

1a. – CA741CS, CA741CT, CA741S, & CA741T with internal phase compensation.

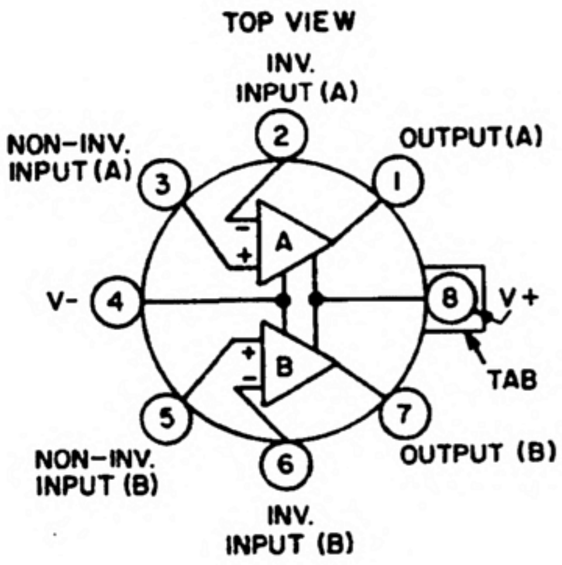


1b. – CA747CT and CA747T with internal phase compensation.

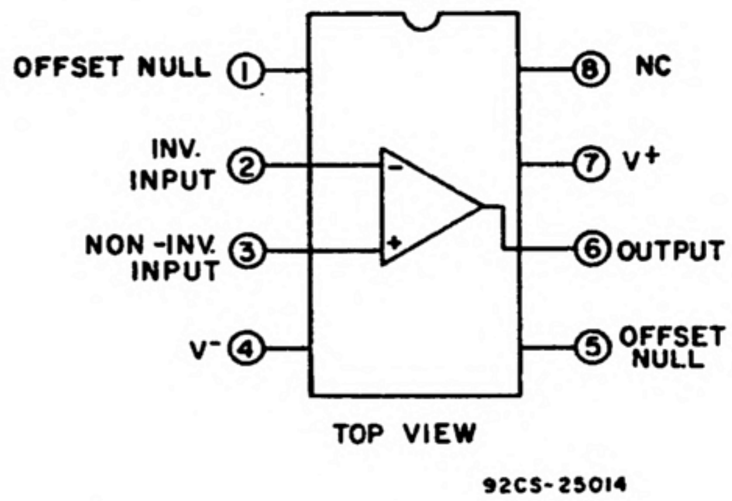


NOTE: PIN 4 IS CONNECTED TO CASE

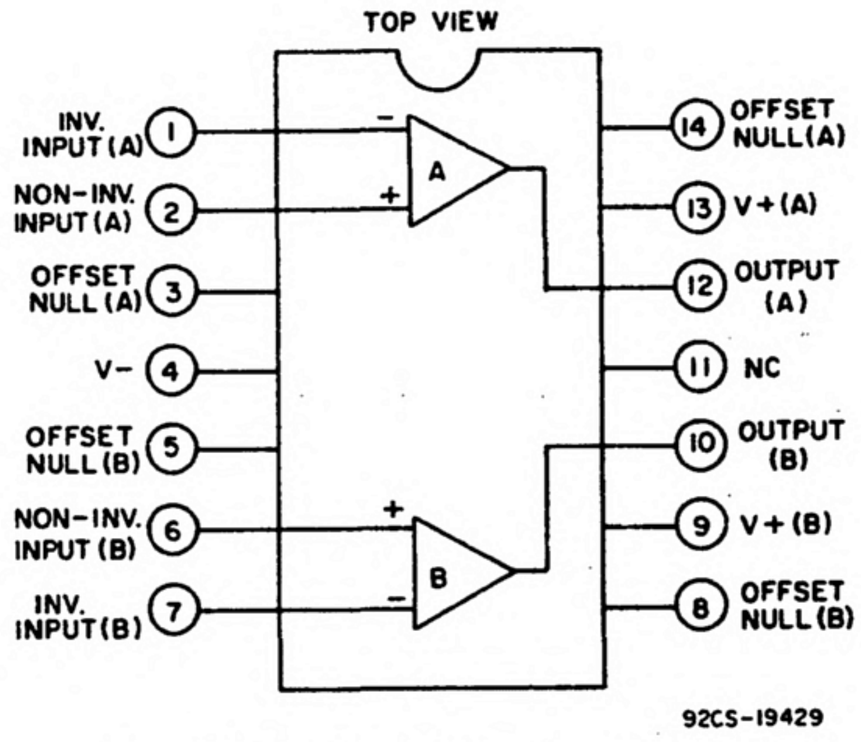
1c. – CA748CS, CA748CT, CA748S, and CA748T with external phase compensation.



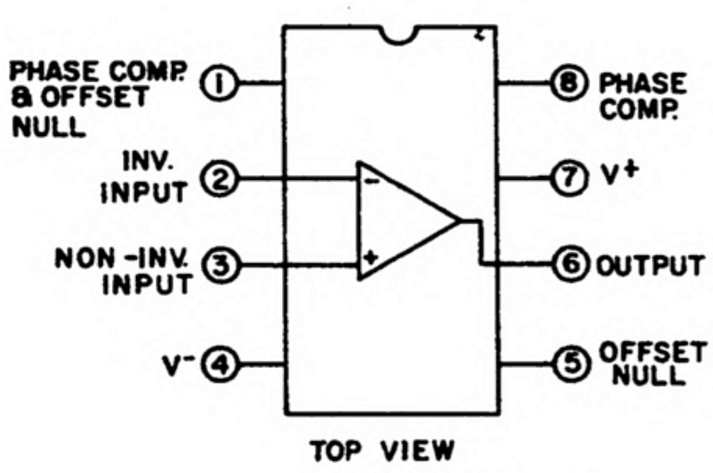
1d. – CA1458S, CA1458T, CA1558S, and CA1558T with internal phase compensation.



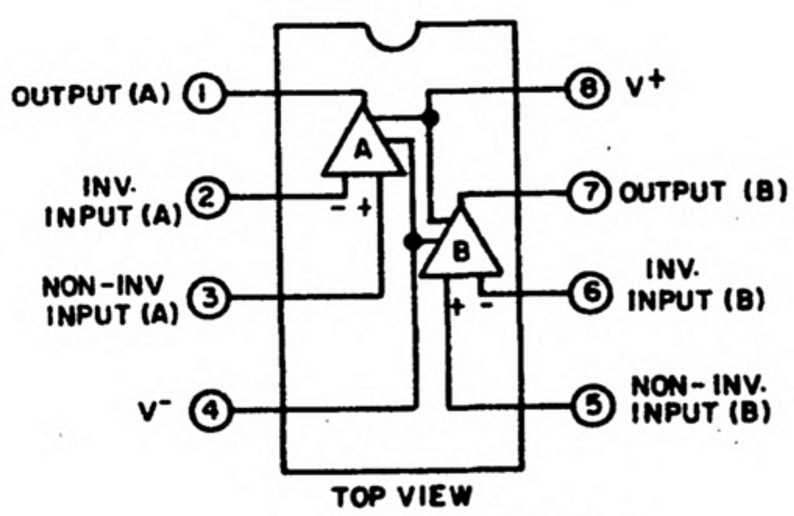
1e. – CA741CE with internal phase compensation.



1f. – CA747CE and CA747E with internal phase compensation.



1g. – CA748CE with external phase compensation.



1h. – CA1458E with internal phase compensation.

Fig. 1 – Functional diagrams.

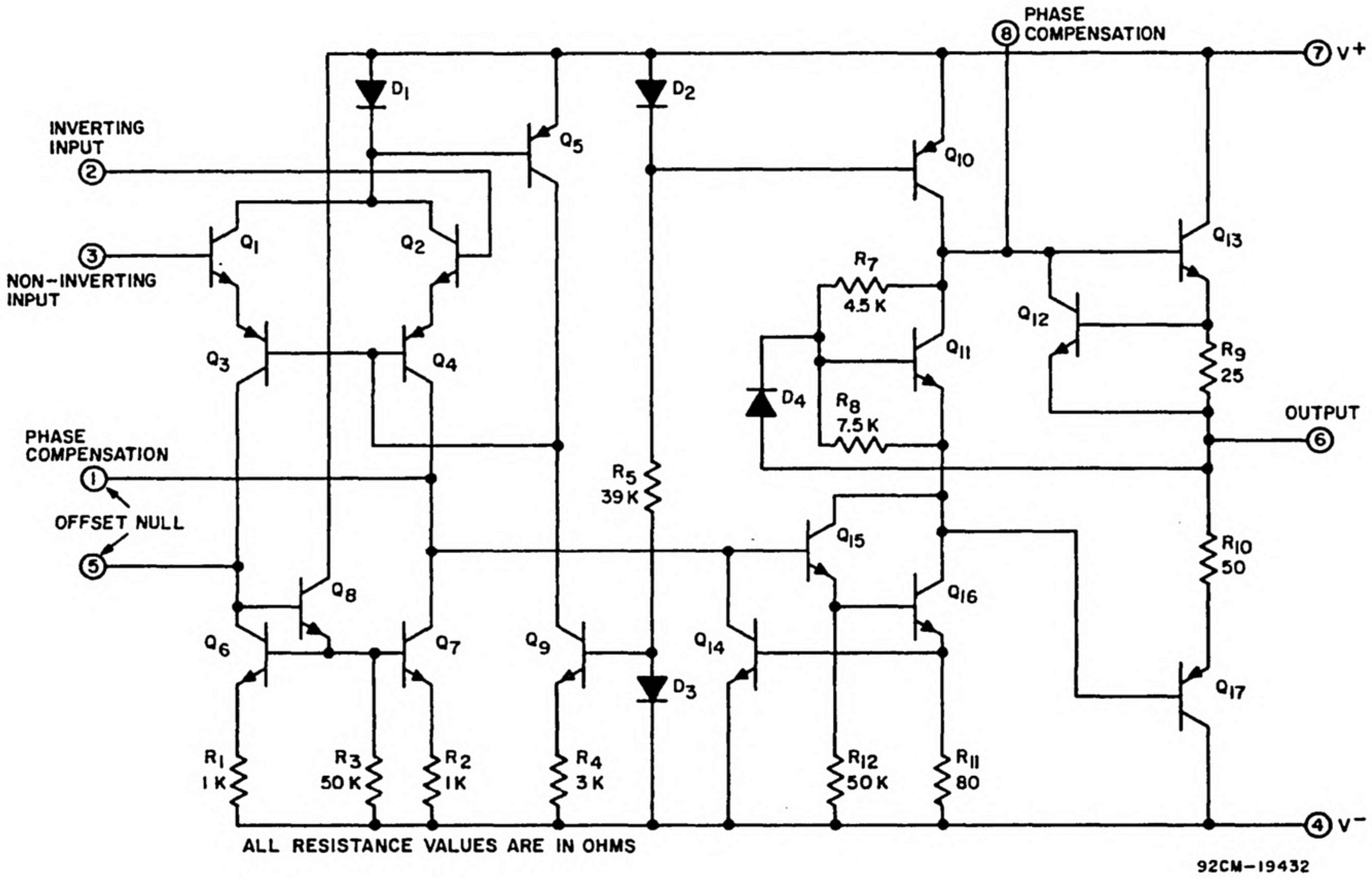


Fig.2—Schematic diagram of operational amplifier with external phase compensation for CA748C and CA748.

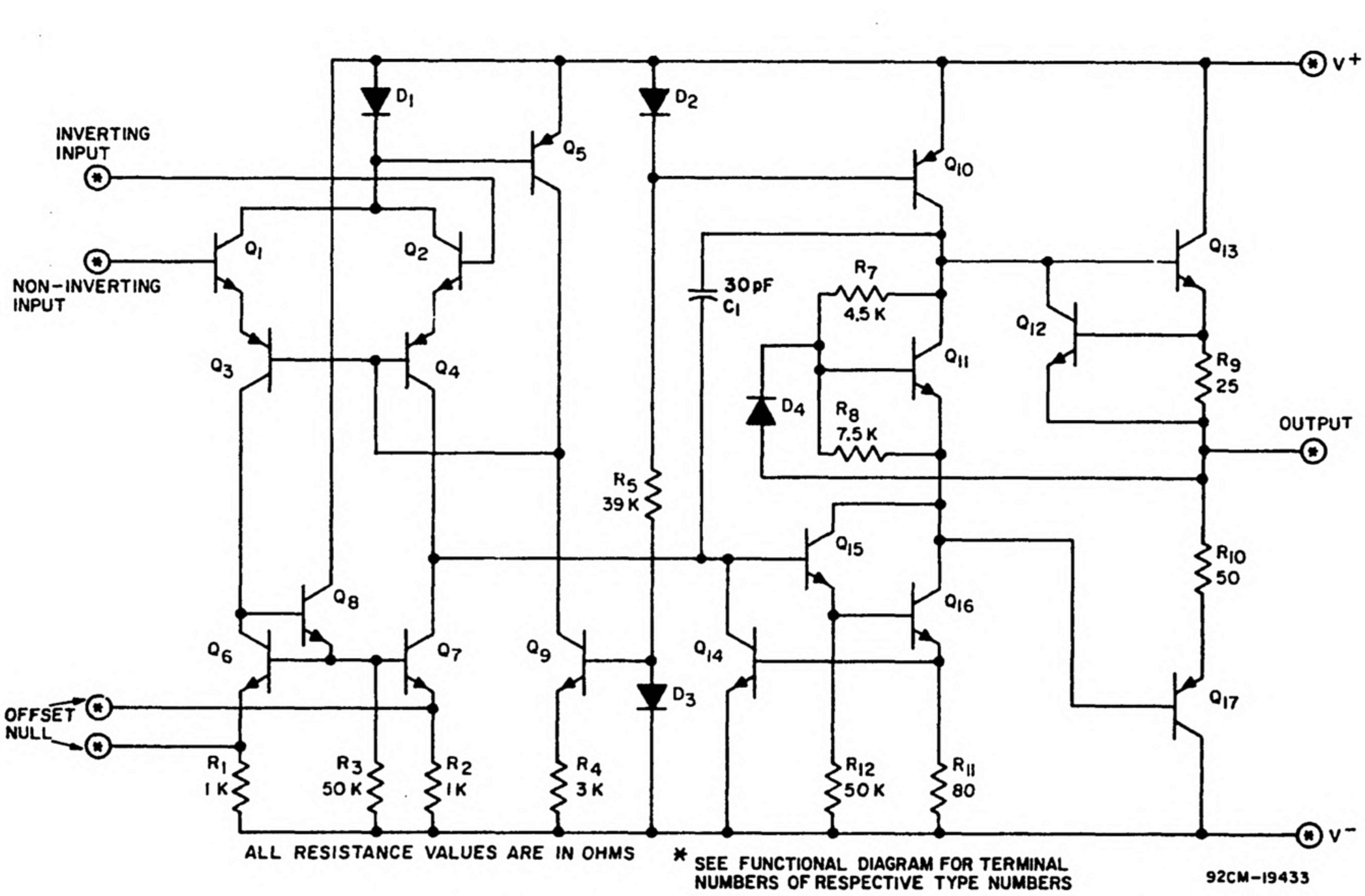


Fig.3—Schematic diagram of operational amplifiers with internal phase compensation for CA741C and CA741 and for each amplifier of the CA747C, CA747, CA1458, and CA1558.

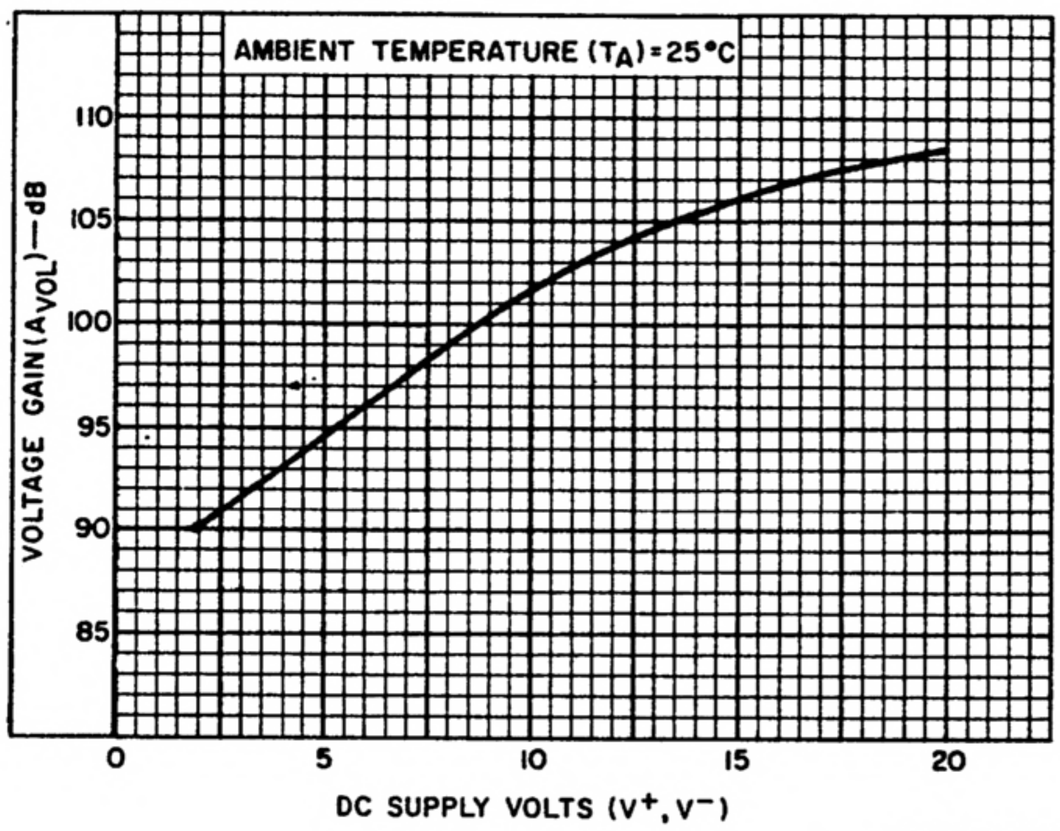


Fig. 4 — Open-loop voltage gain vs. supply voltage for all types except CA748 and CA748C.

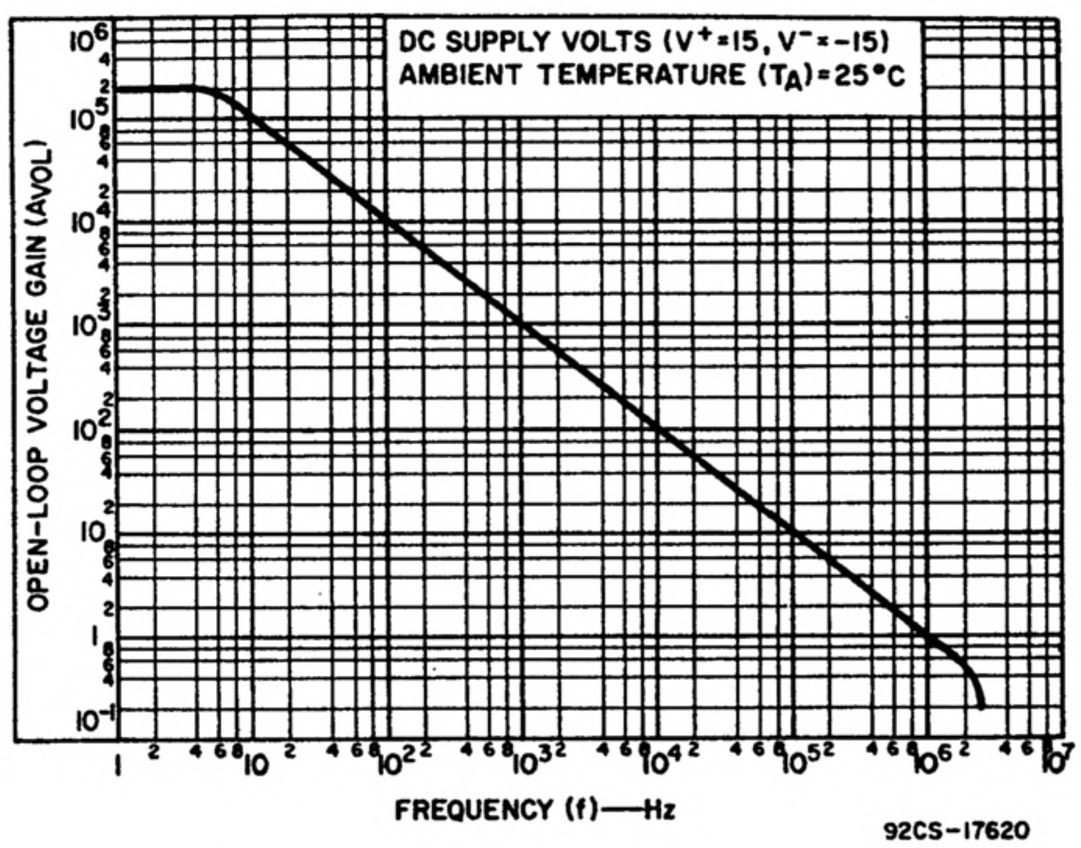


Fig. 5 — Open-loop voltage gain vs. frequency for all types except CA748 and CA748C.

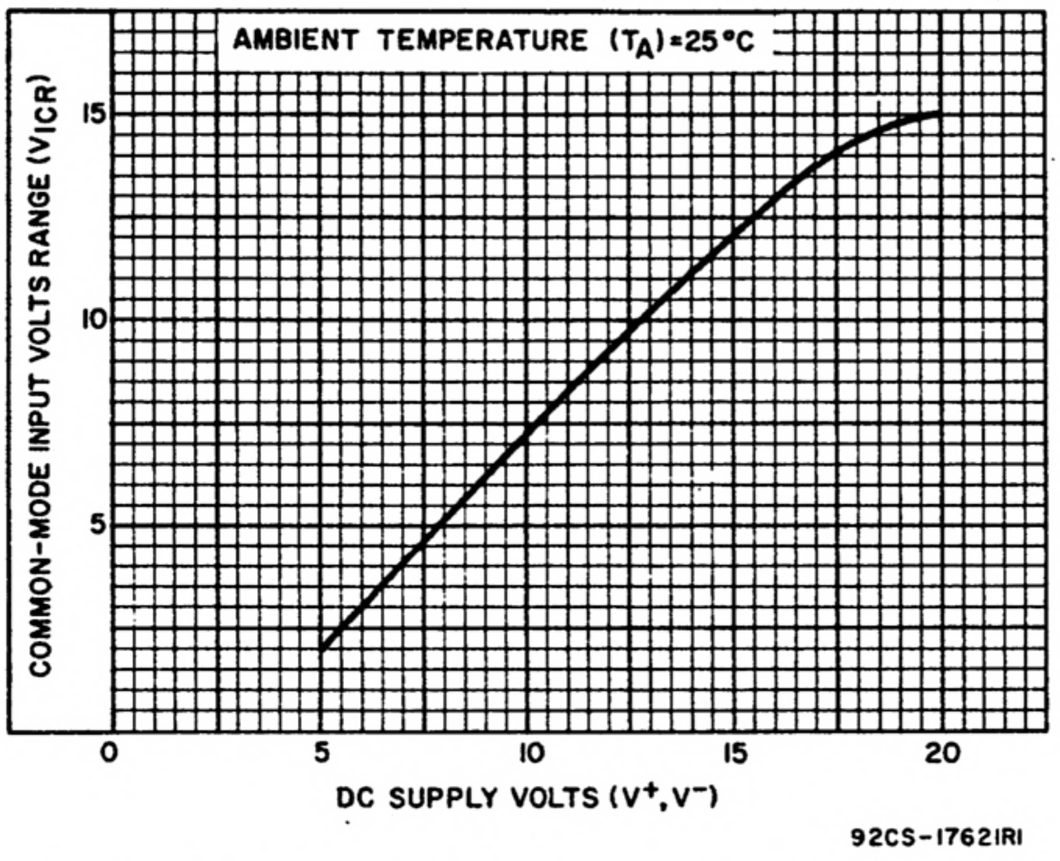


Fig. 6 — Common-mode input voltage range vs. supply voltage for all types.

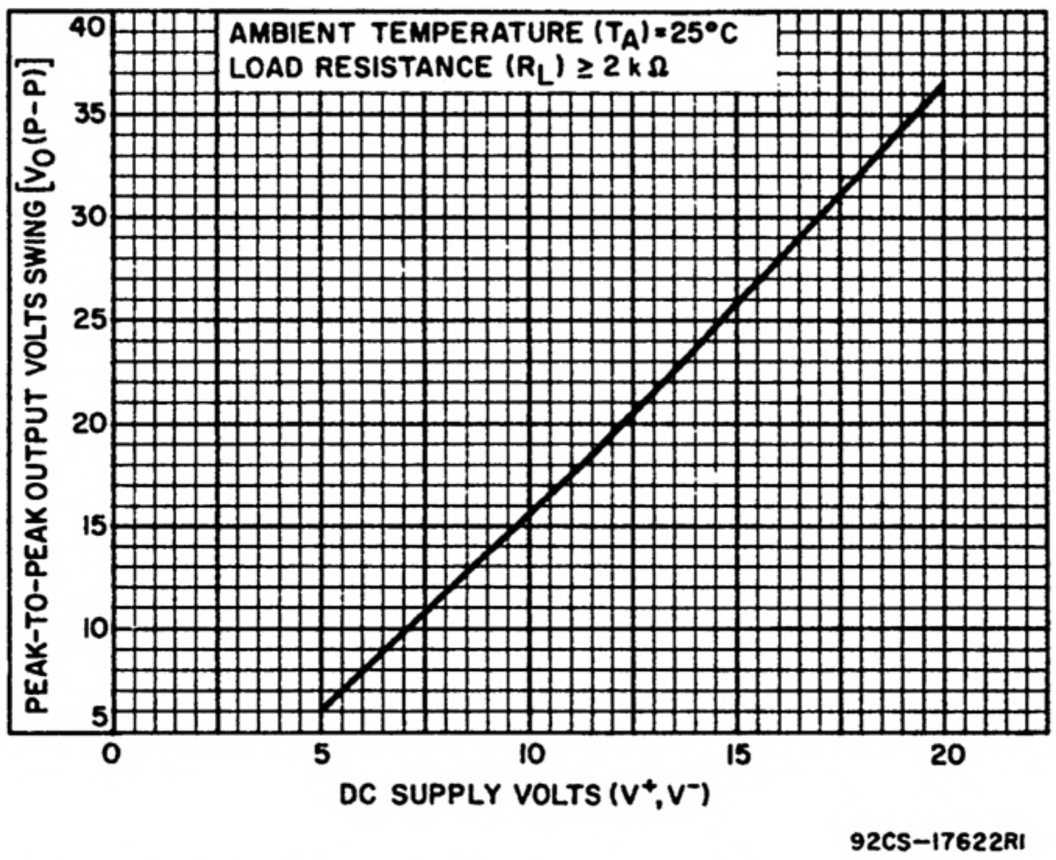


Fig. 7 — Peak-to-peak output voltage vs. supply voltage for all types except CA748 and CA748C.

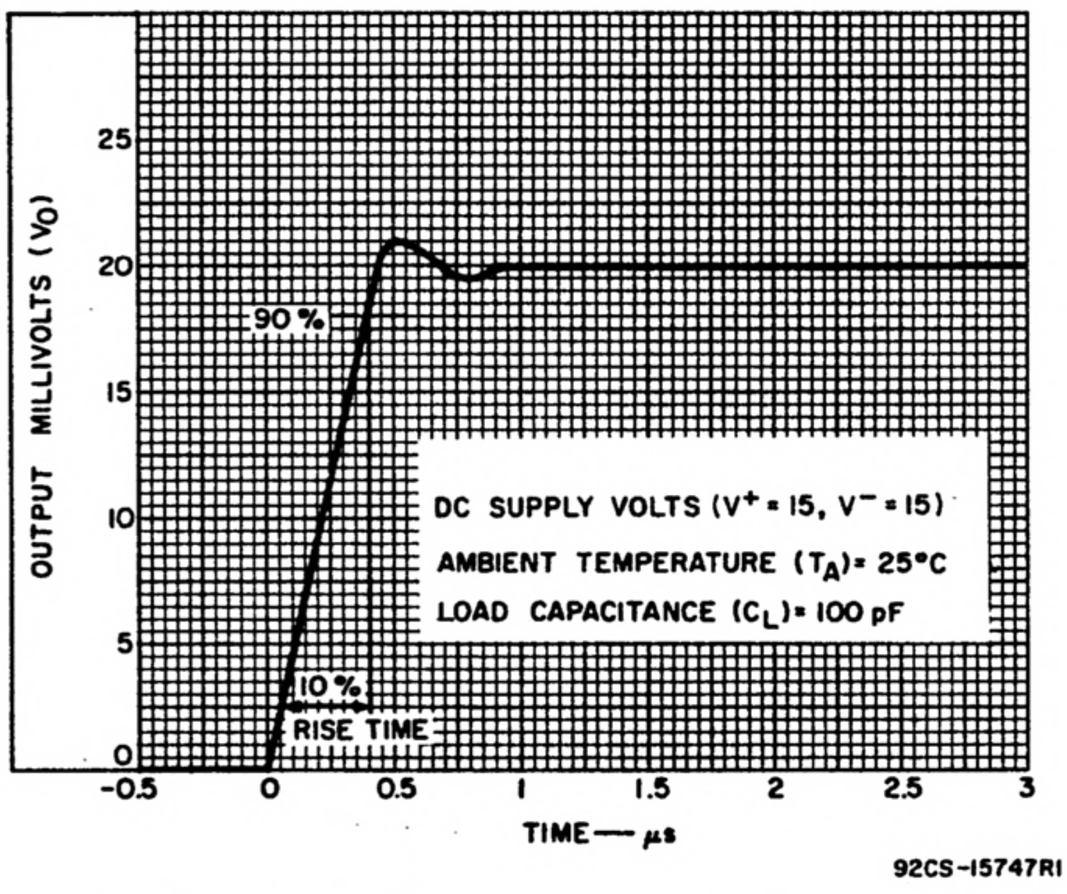


Fig. 8 — Output voltage vs. transient response time for CA741C and CA741.

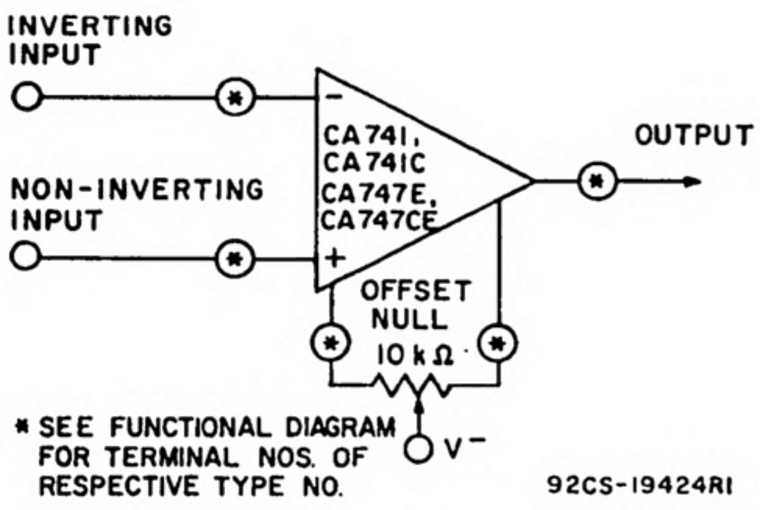


Fig. 9 – Voltage-offset null circuit for CA741C, CA741, CA747CE and CA747E.

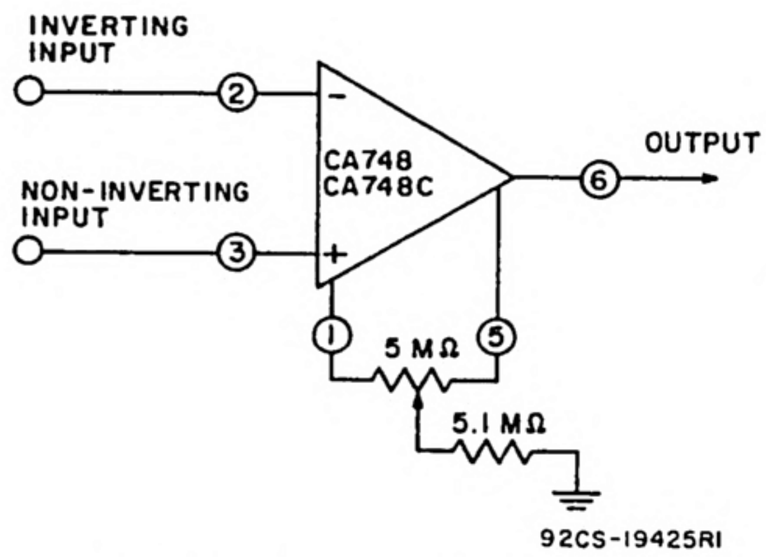


Fig. 10 – Voltage-offset null circuit for CA748C and CA748.

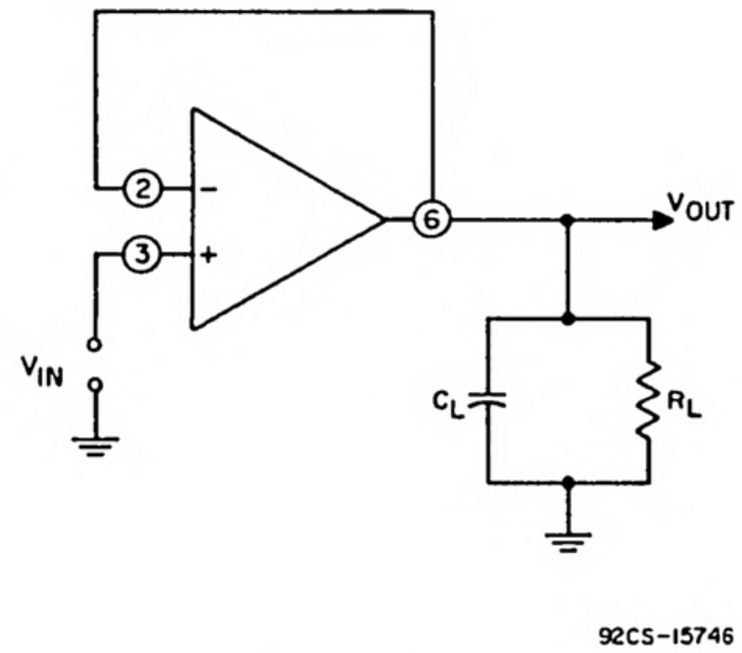


Fig. 11 – Transient response test circuit for all types.