SYSTEME MOTORISE

DE RECEPTION PAR SATELLITE

Nom :
Prénom :
N°
N°

BEP des Métiers de l'Electronique

SESSION 2001

EPREUVE EP3

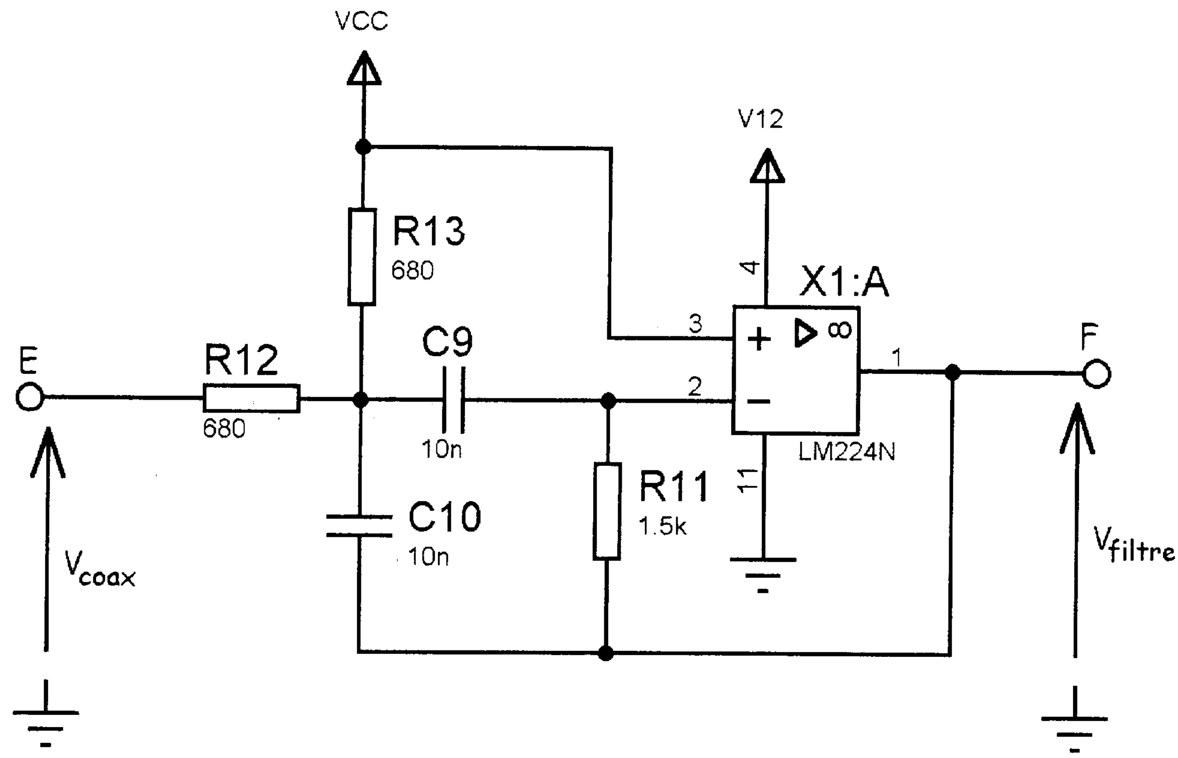
Le candidat doit répondre directement sur ce document qui sera rendu dans son intégralité.

Ce dossier comprend 17 pages de questionnement et 6 pages de documentations constructeurs.

Coefficient : 4 **Durée : 4 heures**

Un téléspectateur regarde une émission diffusée par France 2 et décide de passer sur le canal 101 correspondant à la chaîne TV5. L'étude suivante concerne **seulement** l'ordre de positionnement de la parabole.

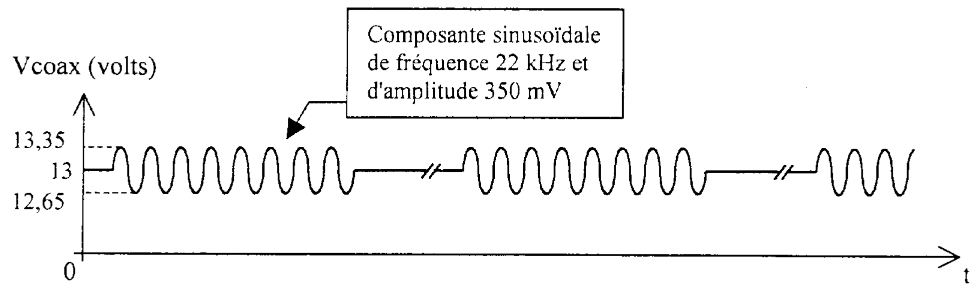
I- Etude de Fs1.1 "Filtrage"



1- Rappelez le rôle de cette fonction.

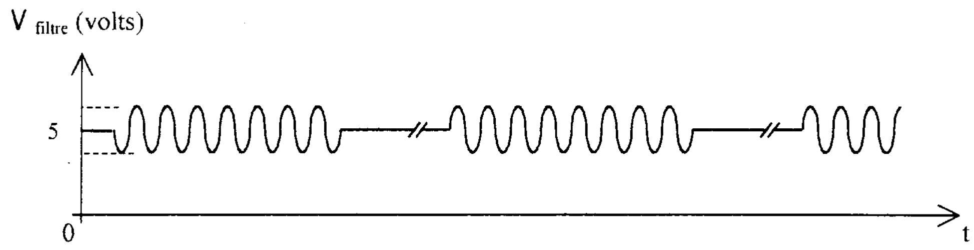
2- Quel est le type de filtre utilisé ?

3- Dans le but de simplifier l'étude du filtre, on considèrera que le signal 22kHz, durant la génération de l'ordre DiSEqC, est représenté de la façon suivante :

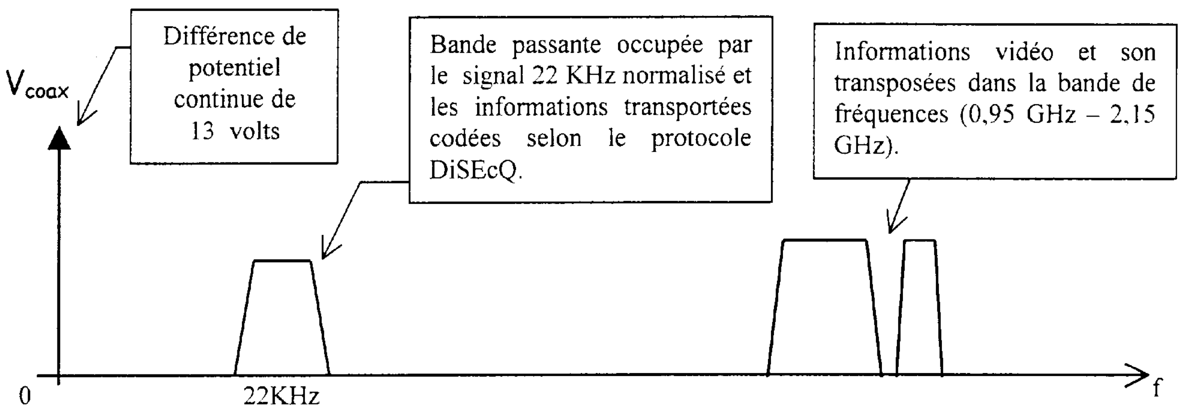


Dans ce cas précis, V_{filtre} est un signal constitué par une composante continue égale à 5 volts (V_{cc}) sur laquelle est superposé un signal sinusoïdal de fréquence 22kHz appelé v_{filtre}.

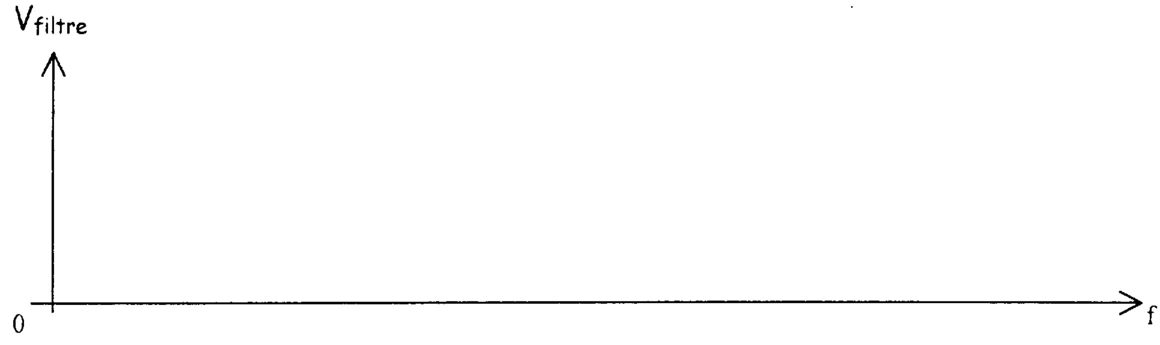
La représentation de V_{filtre} est la suivante :



Lorsque l'utilisateur décide de passer sur le canal 101 (TV5), au moment précis de l'émission du code DiSEqC, le spectre du signal V_{coax} se présente comme suit :



Complétez alors le spectre du signal V_{filtre}.

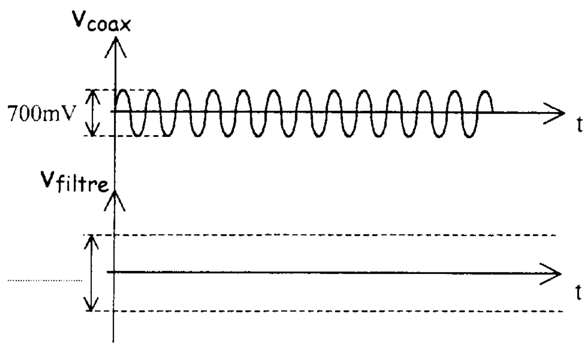


4- Calculez $\underline{A}_0$ et f_0 et notez vos résultats dans le tableau ci-dessous.

Fonction de transfert	$\underline{T}=\frac{\underline{V}_{Filtre}}{\underline{V}_{coax}}=\underline{A}_0\frac{2jm\frac{\omega}{\omega_0}}{1+2jm\frac{\omega}{\omega_0}+\left(\frac{j\omega}{\omega_0}\right)^2}$
Fréquence centrale	$fo=\frac{1}{2\pi C}\sqrt{\frac{R_{12}+R_{13}}{R_{11}R_{12}R_{13}}}=$ ....
Amplification maximale à la fréquence centrale f_0	$\underline{A}_0=-\frac{R_{11}}{2R_{12}}=$ ....
Gain maximal à la fréquence centrale f_0	$G_0=20\log\lvert\underline{A}_0\rvert=20\log\frac{R_{11}}{2R_{12}}=0{,}851\,dB$
Coefficient d'amortissement	$m=\sqrt{\frac{R_{12}R_{13}}{R_{11}(R_{12}+R_{13})}}=0{,}476$
Facteur de qualité	$q=\frac{1}{2m}=1{,}05$
Bande passante à – 3 décibels	$\Delta f=2m\,f_0=21{,}22\,KHz$

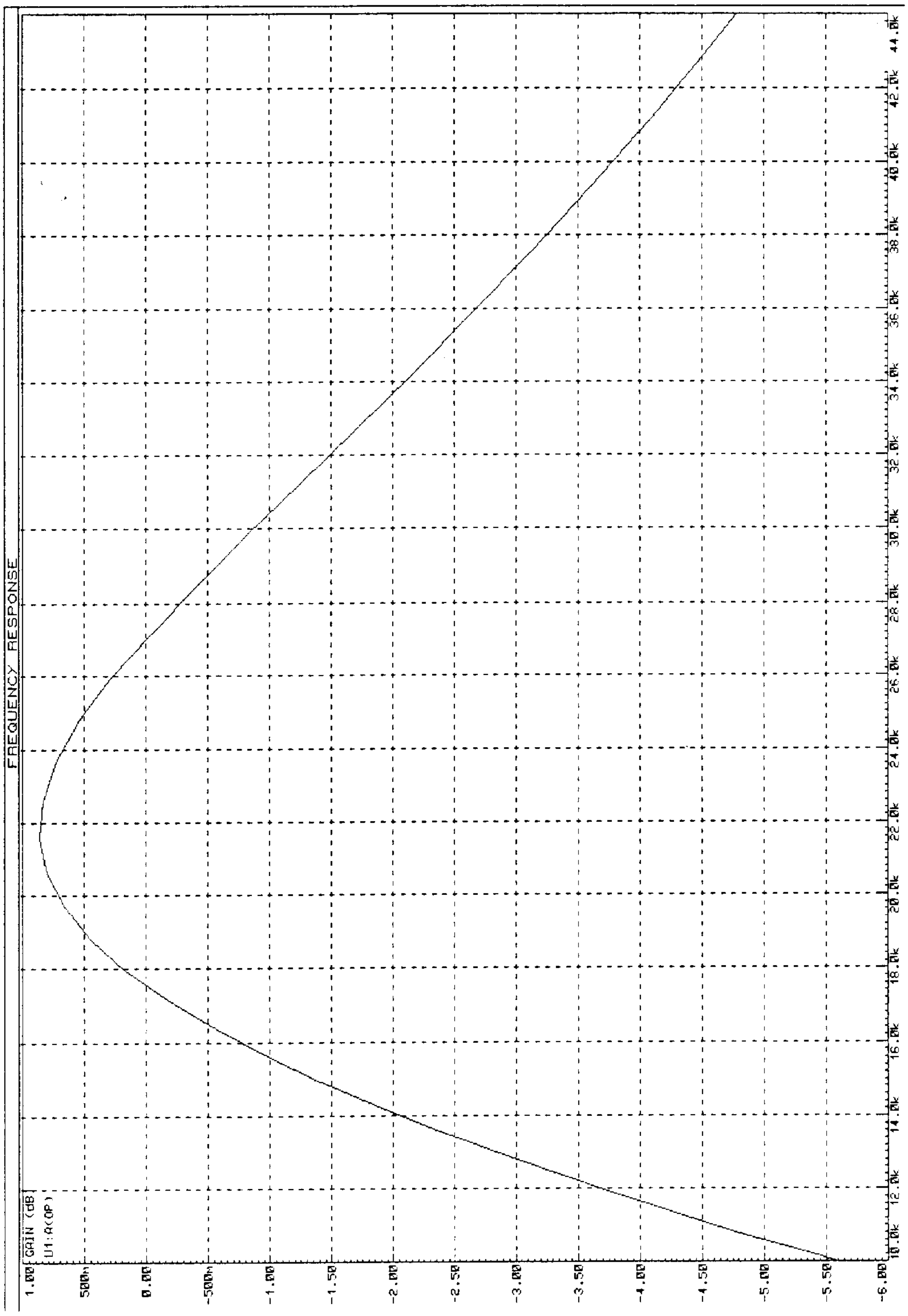
5- A_0 étant négatif, donnez le déphasage entre le signal sinusoïdal de fréquence 22kHz présent dans V_{coax} et le signal sinusoïdal v_{filtre} présent dans V_{filtre} ?

6- L'amplitude du signal sinusoïdal de fréquence 22kHz présent dans V_{coax} est égale à 350mV et à la fréquence f_0, seule la composante sinusoïdale v_{coax} est amplifiée (soit multipliée par $\lvert\underline{A}_0\rvert$). Complétez le chronogramme de v_{filtre} ci-dessous.

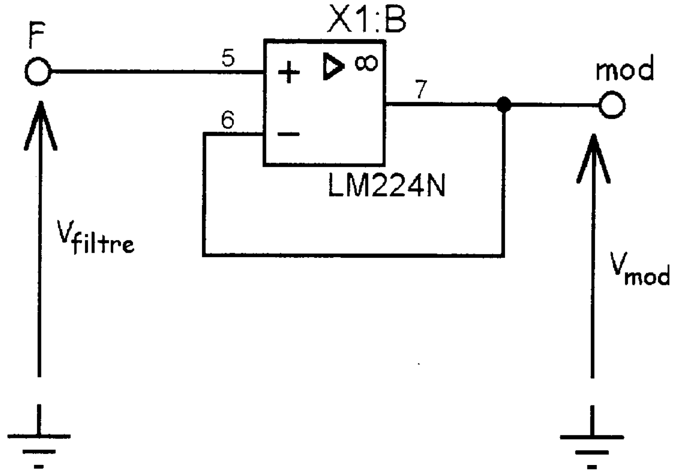


7- Les fréquences f_1 et f_2 sont déterminées pour $G_1 = G_0$ - 3dB et $G_2 = G_0$ - 3dB. Calculez G_1 et G_2.

8- Sur le diagramme de Bode ci-dessous (Gain en décibels en fonction de la fréquence en hertzs), placez G_0, G_1, G_2, f_0, f_1 et f_2. Inscrire leurs valeurs. En déduire la bande passante Δf de ce filtre à -3dB sachant que $\Delta f = f_2 - f_1$.



II- Etude de Fs1.2 "Adaptation d'impédance"

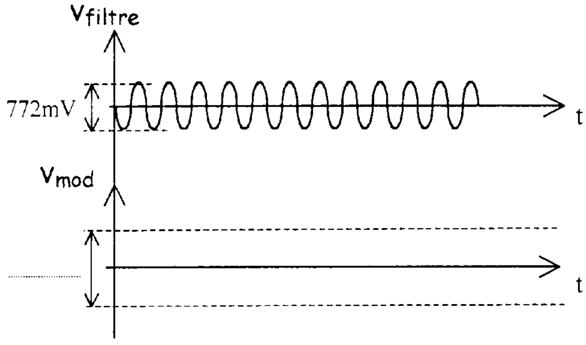


Rappel : $V_{filtre} = v_{filtre} + V_{cc}$ $V_{mod} = v_{mod} + V_{cc}$

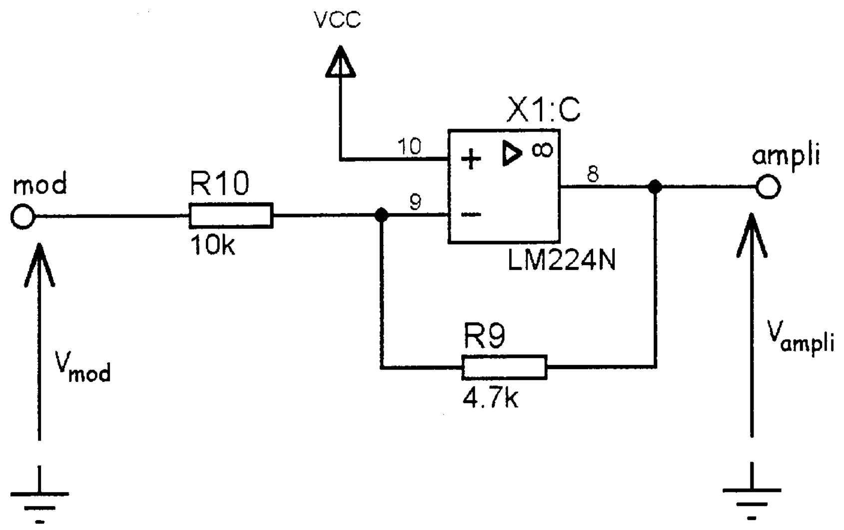
1- Quelle est le nom de cette structure ?

2- Représentez le modèle électrique équivalent à ce circuit et exprimez V_{mod} en fonction de V_{filtre}.

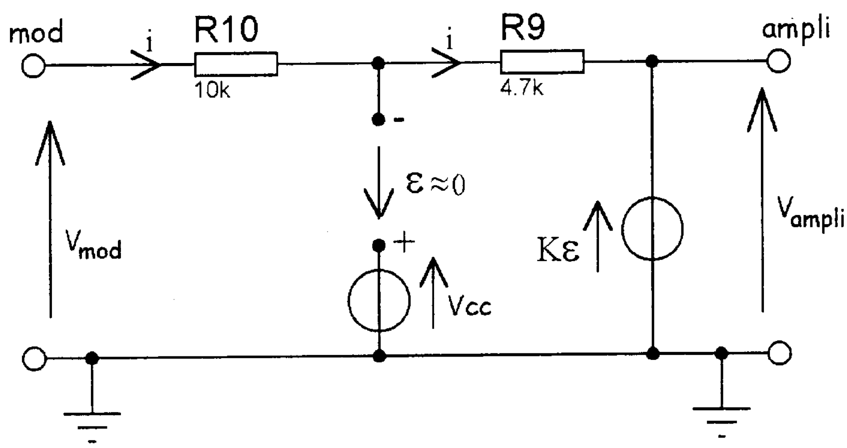
3- Complétez le chronogramme de v_{mod} ci-dessous.



III- Etude de Fs2.1 "Amplification"



Modèle électrique équivalent au circuit



1- Exprimez V_{mod} en fonction de R_{10}, de V_{cc} et de i.

2- Dans l'expression obtenue précédemment, remplacez V_{mod} par $v_{mod} + V_{cc}$.

Après simplification, donnez l'expression de i en fonction de v_{mod} et de R_{10}.

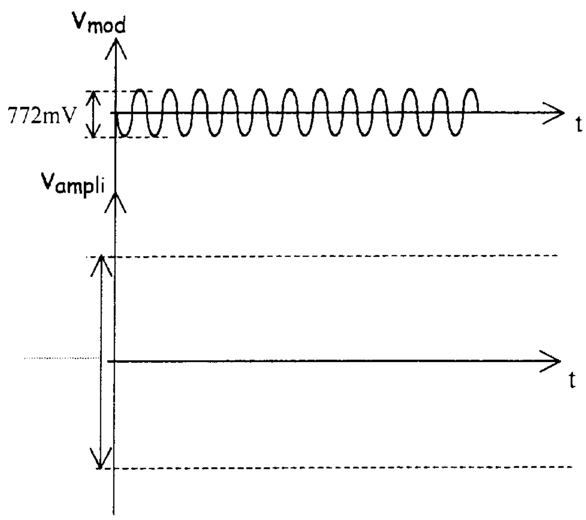
3- Exprimez V_{ampli} en fonction de R_9, de V_{cc} et de i.

4- Déduire des réponses aux questions 2 et 3, l'expression de V_{ampli} en fonction de R_9, de R_{10} et de V_{cc}. -> Vmod ?

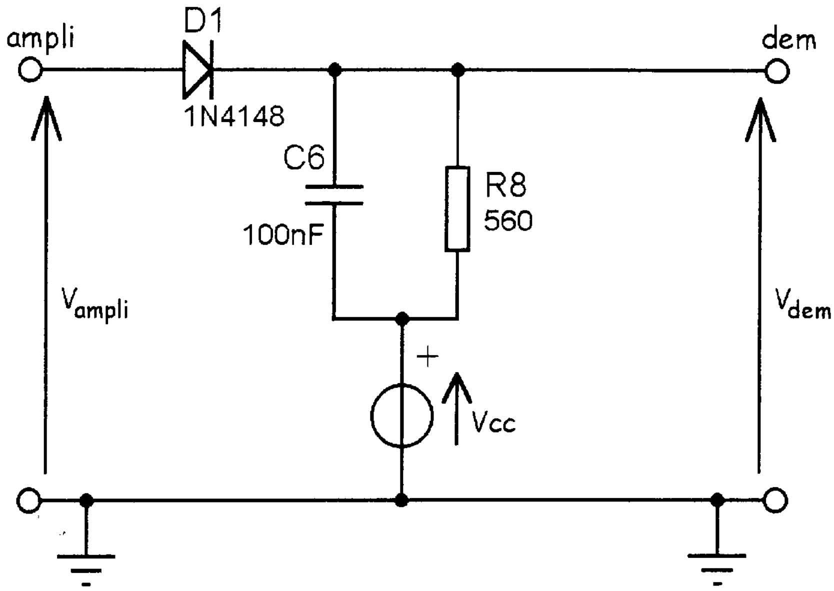
5- Sachant que V_{ampli} peut s'écrire $V_{ampli} = v_{ampli} + V_{cc}$, en déduire l'expression de v_{ampli} sachant que l'amplitude de v_{mod} est égale à 772 millivolts.

Calculez l'amplitude de v_{ampli}.

6- Complétez le chronogramme de v_{ampli} ci-dessous.



IV- Etude de Fs2.2 "Détection de l'enveloppe"

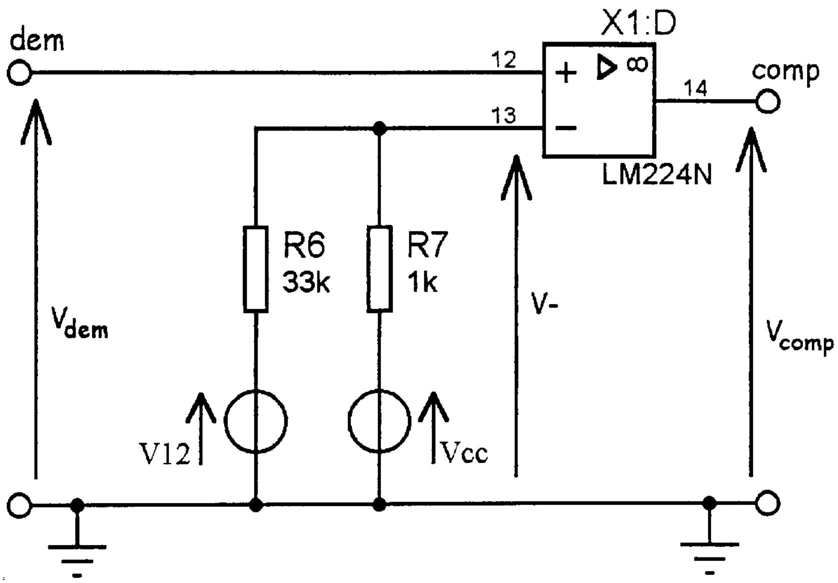


1- Rappelez le rôle de la fonction Fs2.2. "Détection d'enveloppe".

2- Expliquez brièvement le rôle de la diode D_1.

3- Quel rôle remplit l'ensemble R_8 - C_6 au sein de la fonction.

V- Etude de Fs2.3 "Comparaison"



Alimentation de X1 :D : 0, +12v

1- Quel est le régime de fonctionnement de l'amplificateur opérationnel ?

2- Dans ce montage, V_{comp} peut prendre deux valeurs :

-à l'état haut, $V_{comp} = V_{OH}$

-à l'état bas, $V_{comp} = V_{OL}$

A partir de la documentation constructeur du LM224A, indiquez les valeurs numériques réelles de V_{comp} lorsque :

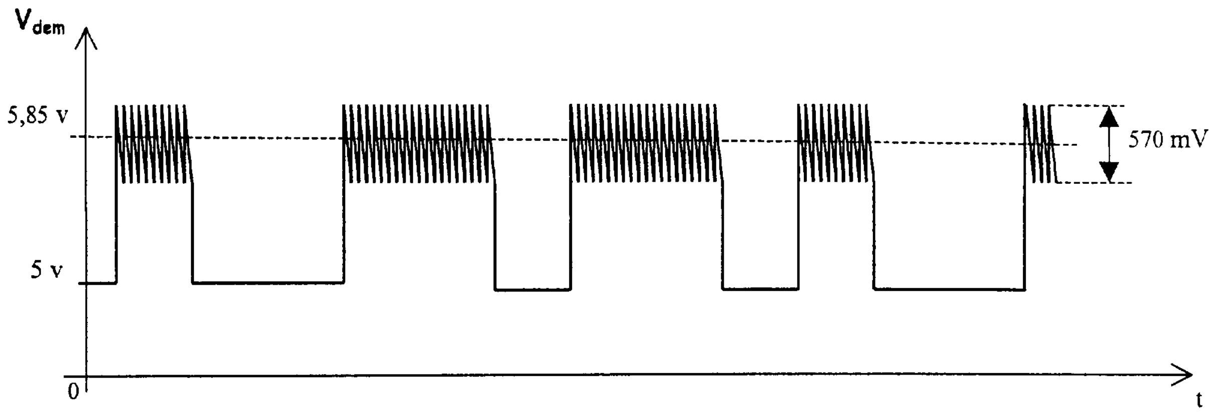
a) $V_{dem} > V^-$

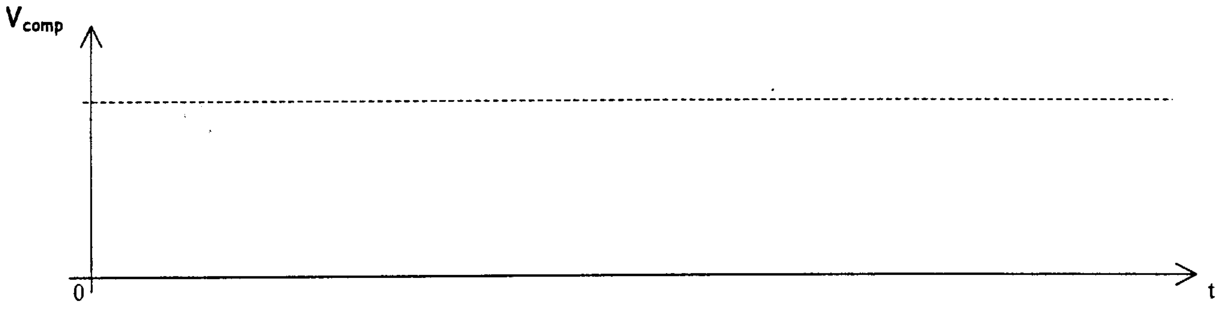
b) $V_{dem} < V^-$

3- En utilisant la méthode de votre choix, montrez que V^- peut s'écrire $V^- = \dfrac{R_6 V_{cc} + R_7 V_{12}}{R_6 + R_7}$

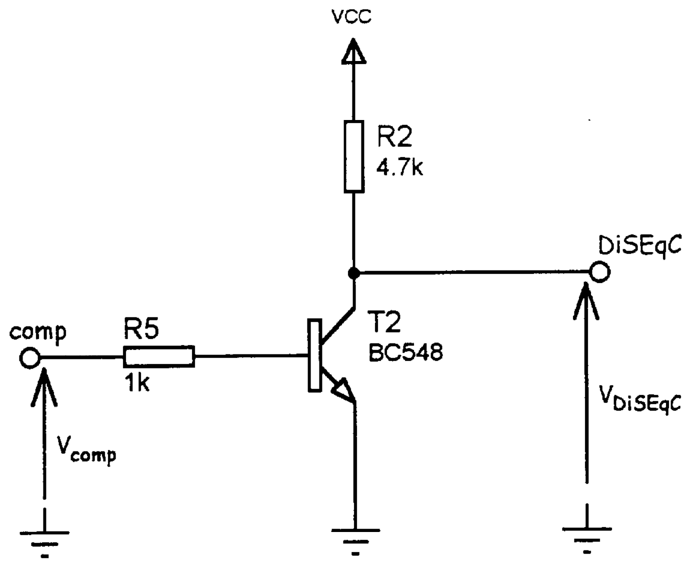
4- Calculez la valeur numérique de V^-.

5- Complétez et graduez le chronogramme de V_{comp} ci-dessous :





VI- Etude de Fs2.4 "Adaptation de niveaux"



Le transistor T2 fonctionne en commutation (soit bloqué soit saturé) (V_{CEsat} = 0,1volt).

1- Lorsque V_{comp} vaut 5 millivolts, quel est l'état du transistor T2 ?

2- En déduire la valeur de V_{DiSEqC} ?

3- Lorsque V_{comp} vaut 10,5 volts, quel est l'état du transistor T2 ?

4- En déduire la valeur de V_{DiSEqC} ?

5- Complétez le tableau suivant.

V_{comp}	Etat électrique de T2 (bloqué ou saturé)	V_{DiSEqC}
0 volt		
10,5 volts		

6- Rappelez et justifiez le rôle de la fonction Fs2.4.

VII- Etude de Fs4.1 "Commande de l'alimentation de la motorisation"

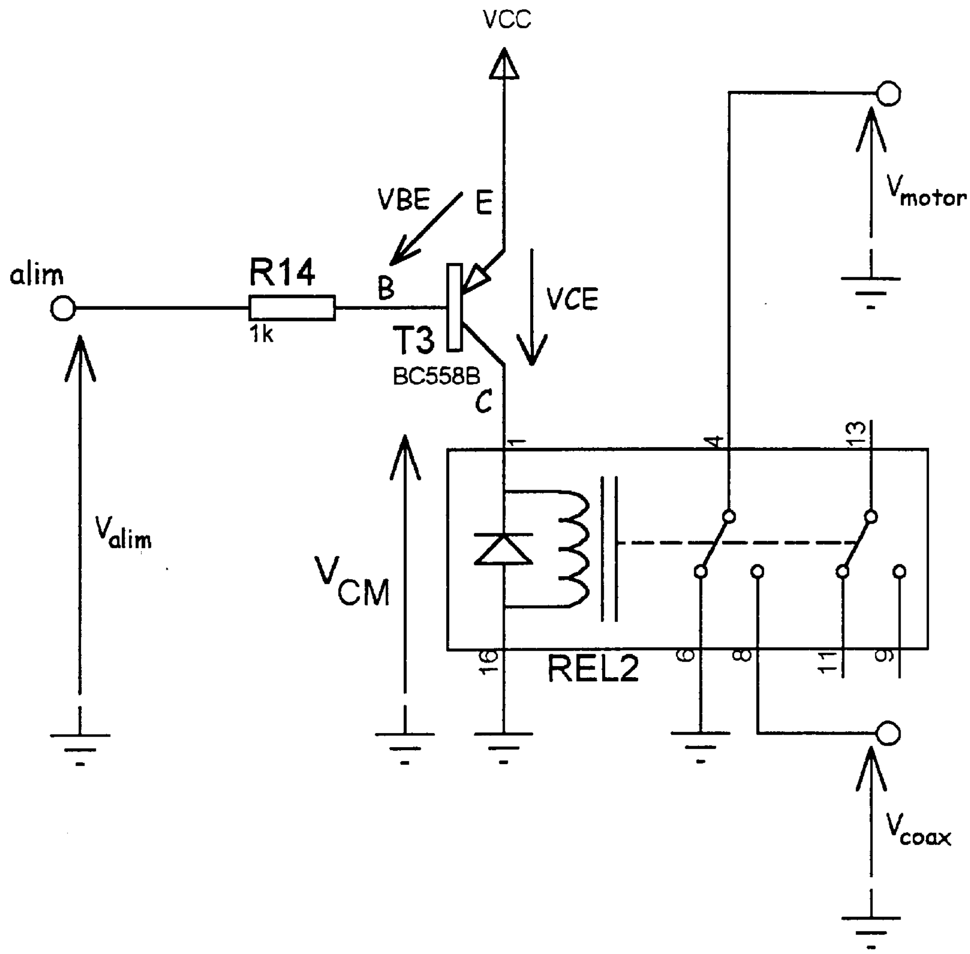


Schéma simplifié de Fs4.1 en régime continu.

Le transistor T3 fonctionne en commutation (soit bloqué soit saturé).
(V_{CEsat} = -0,1volt) . Le relais REL 2 est représenté au repos.

1) Lorsque V_{alim} vaut 0 volt,

a) quel est l'état du transistor T3 ?

b) Donnez l'expression de V_{CM} en fonction de V_{CC} et de V_{CE} . En déduire la valeur de V_{CM} aux bornes du relais REL2 et son état électrique (excité ou non-excité).

c) En déduire l'expression de V_{motor} en fonction de V_{coax}.

d) France 2 et TV5 étant 2 chaînes à polarisation verticale, donnez la valeur numérique de V_{motor}.

e) Quelle est l'incidence sur la parabole ?

2) Lorsque V_{alim} vaut 5 volts,

a) quel est l'état du transistor T3 ?

b) Donnez la valeur de V_{CM} aux bornes du relais REL2 et son état électrique (excité ou non-excité).

c) En déduire la valeur de V_{motor}.

d) Quelle est l'incidence sur la parabole ?

3- Complétez le tableau ci-dessous.

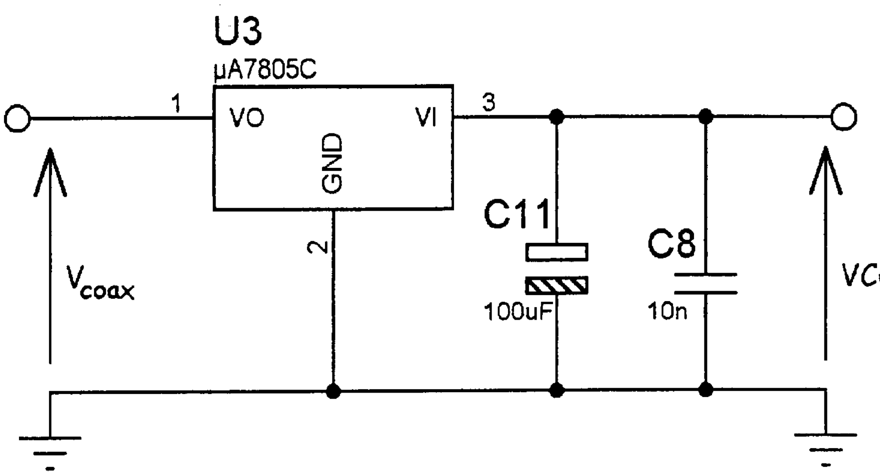
Chaîne visualisée	Valim (V)	Etat de T3 (1)	Etat de REL2 (2)	V_{motor} (V)	Etat de la parabole (3)
France 2	5				
Passage de France 2 vers TV5	0				
TV5	5				

(1) Etat transistor T3 : B = bloqué
S = saturé

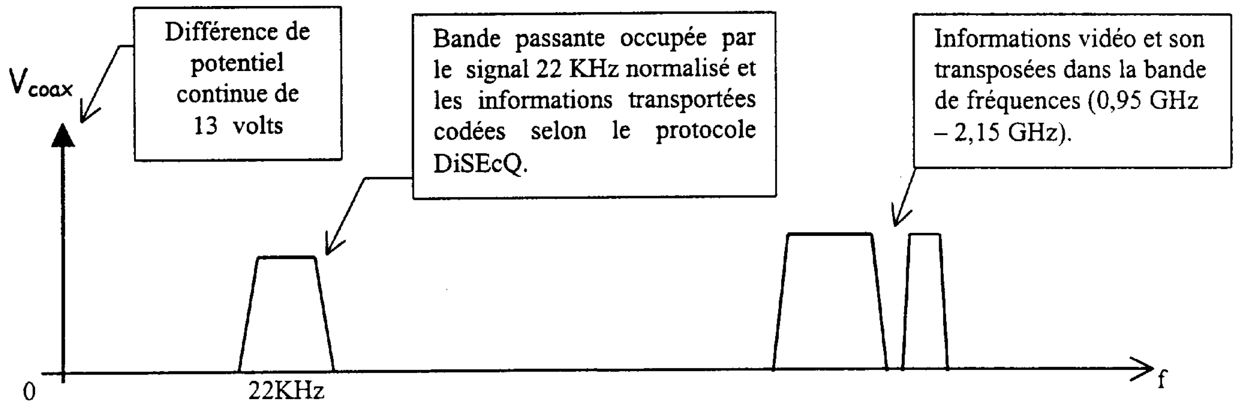
(2) Etat du relais REL2 : E = excité
NE = non excité

(3) Etat de la parabole : R = rotation
A = arrêt

VIII- Etude de FA "alimentation"



Lorsque le téléspectateur regarde France 2, le spectre du signal transporté par le câble coaxial est le suivant :



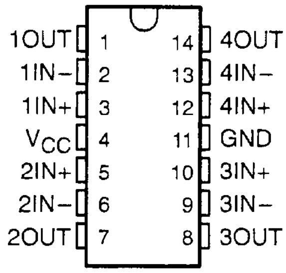
1- Dans le spectre représenté ci-dessus, quelle composante agit sur le circuit µA7805C ? Précisez sa valeur numérique.

2- D'après la documentation constructeur du µA7805C, donner la tension de sortie typique V_{CC} ainsi que la plage dans laquelle doit être comprise la tension d'entrée du régulateur.

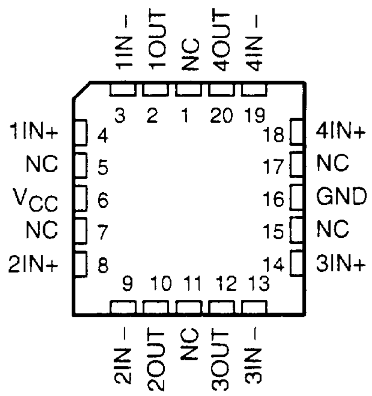
3- Le circuit µA7805C est-il convenablement alimenté ?

- Wide Range of Supply Voltages:
  Single Supply . . . 3 V to 30 V
  (LM2902 and LM2902Q
  3 V to 26 V), or Dual Supplies
- Low Supply Current Drain Independent of Supply Voltage . . . 0.8 mA Typ
- Common-Mode Input Voltage Range Includes Ground Allowing Direct Sensing Near Ground
- Low Input Bias and Offset Parameters:
  Input Offset Voltage . . . 3 mV Typ
  A Versions . . . 2 mV Typ
  Input Offset Current . . . 2 nA Typ
  Input Bias Current . . . 20 nA Typ
  A Versions . . . 15 nA Typ
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . . 32 V (26 V for LM2902 and LM2902Q)
- Open-Loop Differential Voltage Amplification . . . 100 V/mV Typ
- Internal Frequency Compensation

LM124, LM124A . . . J OR W PACKAGE
ALL OTHERS . . . D, DB, N OR PW PACKAGE
(TOP VIEW)

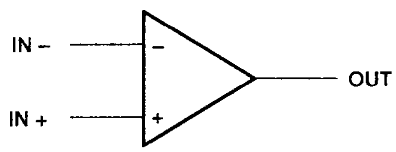


LM124, LM124A . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

symbol (each amplifier)



description

These devices consist of four independent high-gain frequency-compensated operational amplifiers that are designed specifically to operate from a single supply over a wide range of voltages. Operation from split supplies is also possible when the difference between the two supplies is 3 V to 30 V (for the LM2902 and LM2902Q, 3 V to 26 V) and V_{CC} is at least 1.5 V more positive than the input common-mode voltage. The low supply current drain is independent of the magnitude of the supply voltage.

Applications include transducer amplifiers, dc amplification blocks, and all the conventional operational amplifier circuits that now can be more easily implemented in single-supply-voltage systems. For example, the LM124 can be operated directly from the standard 5-V supply that is used in digital systems and easily provides the required interface electronics without requiring additional ±15-V supplies.

The LM2902Q is manufactured to demanding automotive requirements.

The LM124 and LM124A are characterized for operation over the full military temperature range of −55°C to 125°C. The LM224 and LM224A are characterized for operation from −25°C to 85°C. The LM324 and LM324A are characterized for operation from 0°C to 70°C. The LM2902 and LM2902Q are characterized for operation from −40°C to 125°C.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

		LM124, LM124A LM224, LM224A LM324, LM324A	LM2902, LM2902Q	UNIT
Supply voltage, V_{CC} (see Note 1)		32	26	V
Differential input voltage, V_{ID} (see Note 2)		±32	±26	V
Input voltage, V_I (either input)		−0.3 to 32	−0.3 to 26	V
Duration of output short circuit (one amplifier) to ground at (or below) T_A = 25°C, $V_{CC} \le 15$ V (see Note 3)		unlimited	unlimited	
Continuous total dissipation		See Dissipation Rating Table		
Operating free-air temperature range, T_A	LM124, LM124A	−55 to 125		°C
	LM224, LM224A	−25 to 85		
	LM324, LM324A	0 to 70		
	LM2902, LM2902Q		−40 to 125	
Storage temperature range		−65 to 150	−65 to 150	°C
Case temperature for 60 seconds	FK package	260		°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	J or W package	300	300	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D, DB, N, or PW package	260	260	°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values (except differential voltages and V_{CC} specified for the measurement of I_{OS}) are with respect to the network GND.
2. Differential voltages are at IN + with respect to IN −.
3. Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR	DERATE ABOVE T_A	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D	900 mW	7.6 mW/°C	32°C	611 mW	497 mW	N/A
DB	775 mW	6.2 mW/°C	25°C	496 mW	403 mW	N/A
FK	900 mW	11.0 mW/°C	68°C	878 mW	713 mW	273 mW
J (LM124_)	900 mW	11.0 mW/°C	68°C	878 mW	713 mW	273 mW
J (all others)	900 mW	8.2 mW/°C	40°C	654 mW	531 mW	N/A
N	900 mW	9.2 mW/°C	52°C	734 mW	596 mW	N/A
PW	700 mW	5.6 mW/°C	25°C	448 mW	364 mW	N/A
W	900 mW	8.0 mW/°C	37°C	636 mW	516 mW	196 mW

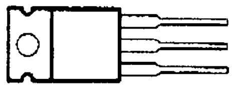
electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	T_A‡	LM124A			LM224A			LM324A			UNIT
				MIN	TYP§	MAX	MIN	TYP§	MAX	MIN	TYP§	MAX	
V_{IO}	Input offset voltage	V_{CC} = 5 V to 30 V, $V_{IC} = V_{ICR}$min, V_O = 1.4 V	25°C			2		2	3		2	3	mV
V_{IO}	Input offset voltage	V_{CC} = 5 V to 30 V, $V_{IC} = V_{ICR}$min, V_O = 1.4 V	Full range			4			4			5	mV
I_{IO}	Input offset current	V_O = 1.4 V	25°C			10			2	15	2	30	nA
I_{IO}	Input offset current	V_O = 1.4 V	Full range			30			30			75	nA
I_{IB}	Input bias current	V_O = 1.4 V	25°C			−50		−15	−80		−15	−100	nA
I_{IB}	Input bias current	V_O = 1.4 V	Full range			−100			−100			−200	nA
V_{ICR}	Common-mode input voltage range	V_{CC} = 30 V	25°C	0 to $V_{CC}-1.5$			0 to $V_{CC}-1.5$			0 to $V_{CC}-1.5$			V
V_{ICR}	Common-mode input voltage range	V_{CC} = 30 V	Full range	0 to $V_{CC}-2$			0 to $V_{CC}-2$			0 to $V_{CC}-2$			V
V_{OH}	High-level output voltage	R_L = 2 kΩ	25°C	$V_{CC}-1.5$			$V_{CC}-1.5$			$V_{CC}-1.5$			V
V_{OH}	High-level output voltage	V_{CC} = 30 V, R_L = 2 kΩ	Full range	26			26			26			V
V_{OH}	High-level output voltage	V_{CC} = 30 V, R_L ≥ 10 kΩ	Full range	27			27	28		27	28		V
V_{OL}	Low-level output voltage	R_L ≤ 10 kΩ	Full range			20		5	20		5	20	mV
A_{VD}	Large-signal differential voltage amplification	V_{CC} = 15 V, V_O = 1 V to 11 V, R_L = ≥ 2 kΩ	Full range	25			25			15			V/mV
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}$min	25°C	70			70	80		65	80		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC}/\Delta V_{IO}$)		25°C	65			65	100		65	100		dB
V_{O1}/V_{O2}	Crosstalk attenuation	f = 1 kHz to 20 kHz	25°C		120			120			120		dB
I_O	Output current	V_{CC} = 15 V, V_{ID} = 1 V, V_O = 0	25°C	−20			−20	−30	−60	−20	−30	−60	mA
I_O	Output current	V_{CC} = 15 V, V_{ID} = 1 V, V_O = 0	Full range	−10			−10			−10			mA
I_O	Output current	V_{CC} = 15 V, V_{ID} = −1 V, V_O = 15 V	25°C	10			10	20		10	20		mA
I_O	Output current	V_{CC} = 15 V, V_{ID} = −1 V, V_O = 15 V	Full range	5			5			5			mA
I_O	Output current	V_{ID} = −1 V, V_O = 200 mV	25°C	12			12	30		12	30		μA
I_{OS}	Short-circuit output current	V_{CC} at 5 V, GND at −5 V, V_O = 0	25°C		±40	±60		±40	±60		±40	±60	mA
I_{CC}	Supply current (four amplifiers)	V_O = 2.5 V, No load	Full range		0.7	1.2		0.7	1.2		0.7	1.2	mA
I_{CC}	Supply current (four amplifiers)	V_{CC} = 30 V, V_O = 15 V, No load	Full range		1.4	3		1.4	3		1.4	3	mA

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified.
‡ Full range is −55°C to 125°C for LM124A, −25°C to 85°C for LM224A, and 0°C to 70°C for LM324A.
§ All typical values are at T_A = 25°C.

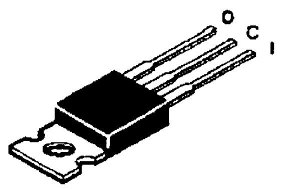
- **3-Terminal Regulators**
- **Output Current Up to 1.5 A**
- **Internal Thermal Overload Protection**
- **High Power Dissipation Capability**
- **Internal Short-Circuit Current Limiting**
- **Output Transistor Safe-Area Compensation**
- **Direct Replacements for Fairchild μA7800 Series**

KC PACKAGE
(TOP VIEW)



The common terminal is in electrical contact with the mounting base.

TO–220AB



description

This series of fixed-voltage monolithic integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of output current. The internal current limiting and thermal shutdown features of these regulators make them essentially immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents and also used as the power-pass element in precision regulators.

The μA7800C series is characterized for operation over the virtual junction temperature range of 0°C to 125°C. The μA7805Q and μA7812Q are characterized for operation over the virtual junction temperature range of −40°C to 125°C.

AVAILABLE OPTIONS

T_J	$V_{O(nom)}$ (V)	PACKAGED DEVICES PLASTIC FLANGE-MOUNT (KC)	CHIP FORM (Y)
0°C to 125°C	5	μA7805CKC	μA7805Y
	6	μA7806CKC	μA7806Y
	8	μA7808CKC	μA7808Y
	8.5	μA7885CKC	μA7885Y
	10	μA7810CKC	μA7810Y
	12	μA7812CKC	μA7812Y
	15	μA7815CKC	μA7815Y
	18	μA7818CKC	μA7818Y
	24	μA7824CKC	μA7824Y
−40°C to 125°C	5	μA7805QKC	—
	12	μA7812QKC	—

absolute maximum ratings over operating temperature ranges (unless otherwise noted)†

Input voltage, V_I: μA7824C	40 V
All others	35 V
Continuous total power dissipation at (or below) 25°C free-air temperature (see Note 1)	2 W
Continuous total power dissipation at (or below) 90°C case temperature (see Note 1)	15 W
Operating free-air, T_A, case, T_C, or virtual junction, T_J, temperature range	−40 to 150°C
Storage temperature range, T_{stg}	−65 to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: For operation above 25°C free-air or 90°C case temperature, refer to Figures 1 and 2. To avoid exceeding the design maximum virtual junction temperature, these ratings should not be exceeded. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

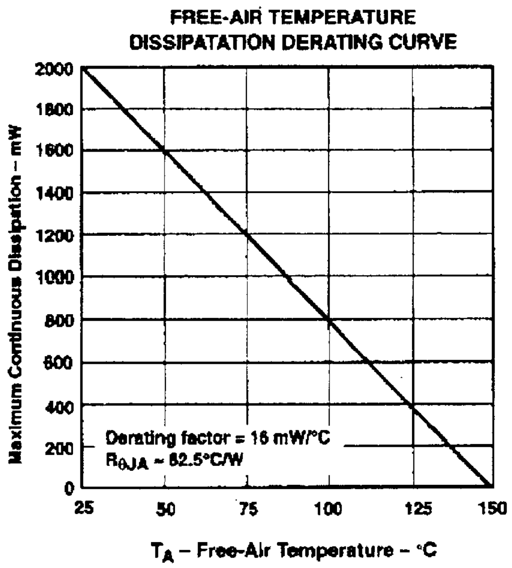


Figure 1

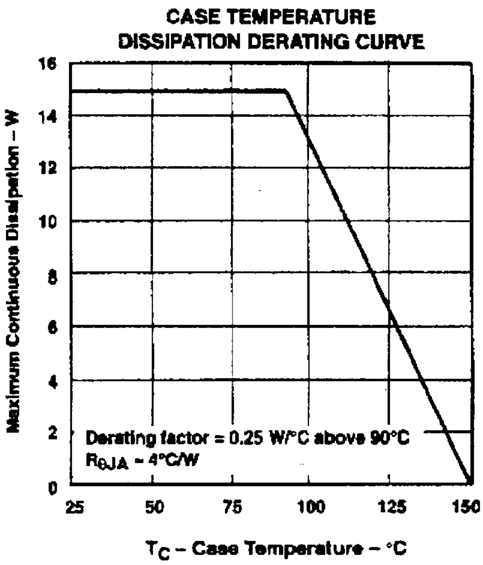


Figure 2

recommended operating conditions

		MIN	MAX	UNIT
Input voltage, V_I	µA7805C	7	25	V
	µA7806C	8	25	
	µA7808C	10.5	25	
	µA7885C	10.5	25	
	µA7810C	12.5	28	
	µA7812C	14.5	30	
	µA7815C	17.5	30	
	µA7818C	21	33	
	µA7824C	27	38	
Output current, I_O			1.5	A
Operating virtual junction temperature, T_J	µA7800C Series	0	125	°C
	µA7805Q, µA7812Q	−40	125	

electrical characteristics at specified virtual junction temperature, V_I = 10 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J†	µA7805C, µA7805Q MIN	TYP	MAX	UNIT
Output voltage‡		25°C	4.8	5	5.2	V
	I_O = 5 mA to 1 A, V_I = 7 V to 20 V, P ≤ 15 W	Full range§	4.75		5.25	
Input voltage regulation	V_I = 7 V to 25 V	25°C		3	100	mV
	V_I = 8 V to 12 V			1	50	
Ripple rejection	V_I = 8 V to 18 V, f = 120 Hz	Full range§	62	78		dB
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		15	100	mV
	I_O = 250 mA to 750 mA			5	50	
Output resistance	f = 1 kHz	Full range§		0.017		Ω
Temperature coefficient of output voltage	I_O = 5 mA	Full range§		−1.1		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		40		µV
Dropout voltage	I_O = 1 A	25°C		2		V
Bias current		25°C		4.2	8	mA
Bias current change	V_I = 7 V to 25 V	Full range§			1.3	mA
	I_O = 5 mA to 1 A				0.5	
Short-circuit output current		25°C		750		mA
Peak output current		25°C		2.2		A

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-µF capacitor across the input and a 0.1-µF capacitor across the output.
‡ This specification applies only for dc power dissipation permitted by absolute maximum ratings.
§ Full range virtual junction temperature is 0°C to 125°C for the µA7805C and −40°C to 125°C for the µA7805Q.