RECEPTEUR NAVTEX
FURUNO NX300

DOSSIER TECHNIQUE

A) LE SYSTEME NAVTEX

1) INTRODUCTION

Le système NAVTEX a été développé afin de pouvoir fournir automatiquement, à tous les marins, les renseignements de la sécurité maritime.

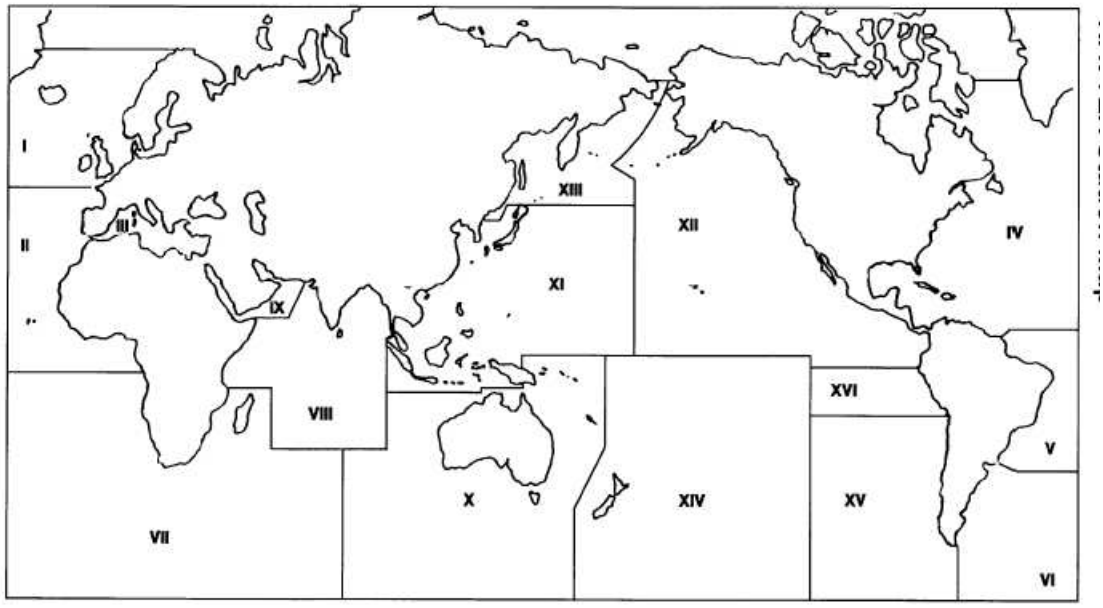
NAVTEX est l'abréviation de « Navigational Télex », c'est un système de transmission radio type télex.

Les récepteurs NAVTEX embarqués, restent toujours en veille. Ils visualisent et enregistrent ou impriment les messages dès leur réception. Il est possible de choisir les messages reçus selon la zone de navigation et selon le type de message (avis d'urgence, avis météorologiques, prévisions météo etc).

Le système NAVTEX contribue à la sécurité en mer, par la connaissance des prévisions météorologiques, et de tout évènement pouvant présenter un danger pour les usagers de la mer.

2) PRINCIPE DE FONCTIONNEMENT

A l'usage de la navigation, le monde a été divisé en 16 zones (appelées Navareas) comme indiqué dans le schéma ci-dessous. Chaque Navarea possède de multiples stations et chaque station NAVTEX a un code d'identification, de A à Z. La fréquence assignée au NAVTEX est unique (518kHz), et plusieurs stations existent dans la même Navarea.

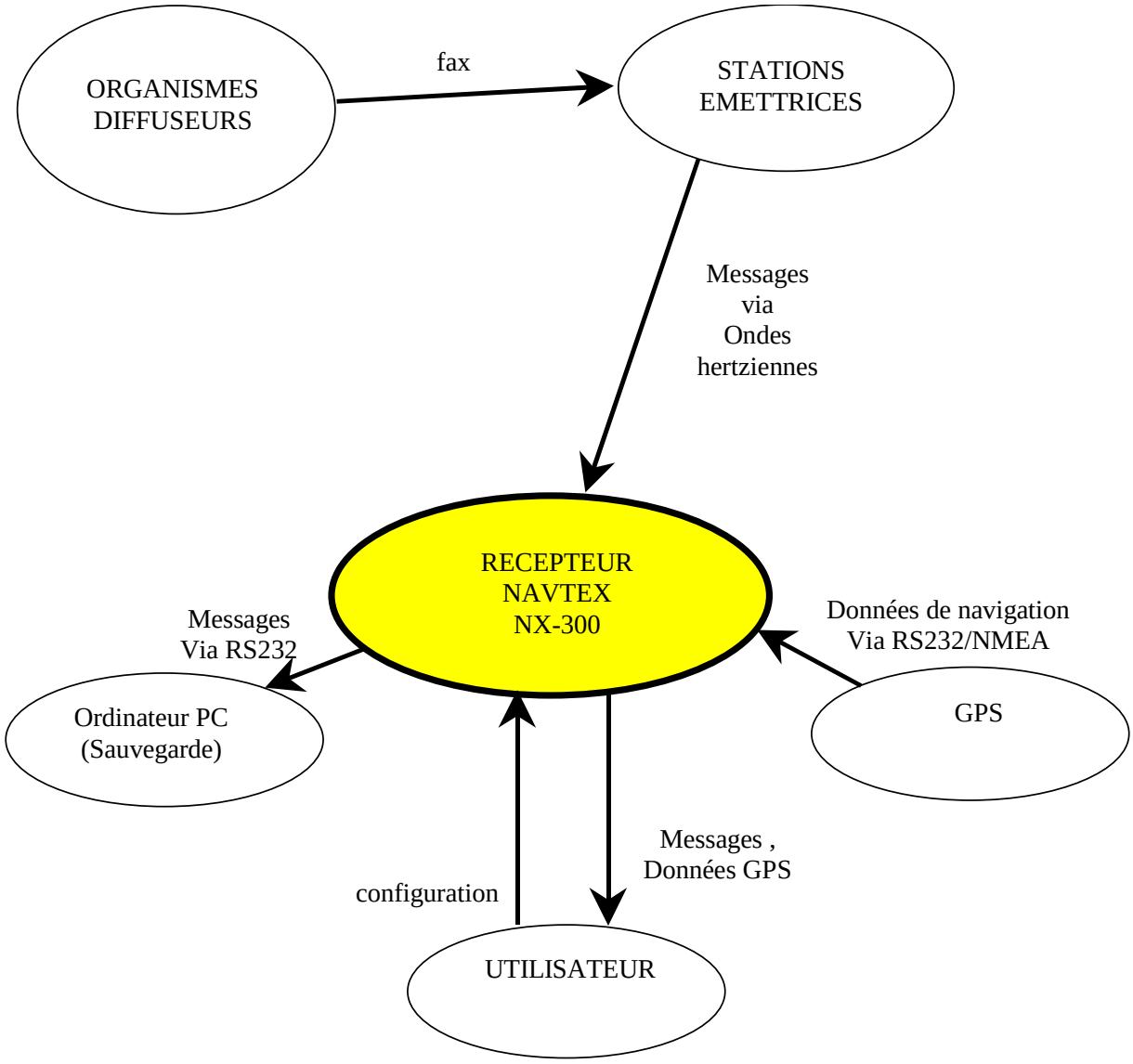


Si les stations transmettaient les messages sans règle, le système serait perturbé à cause des interférences mutuelles. Pour éviter ce problème, les règles suivantes sont appliquées.

- Les stations émettent à tour de rôle , à heure fixe, pendant 10mn toutes les 4 heures. Ainsi, il n'y a pas chevauchement d'émission différentes.
- Chaque station émet avec un minimum de puissance pour couvrir la zone (400 milles nautiques nominal soit environ 740km).

Sur 518kHz tous les messages et bulletins météorologiques sont rédigés en anglais. Certains pays, dont la France, mettent en œuvre un NAVTEX en langue locale. Le fonctionnement est rigoureusement identique excepté la fréquence qui est de 490kHz.

3) DIAGRAMME SAGITTAL



- ✓ Les organismes diffuseurs sont le CROSS (Centre Régionaux Opérationnels de Surveillance et de Sauvetage) , la marine nationale, météo-France.

- ✓ Les stations sont disposées le long du littoral.

En France pour couvrir le littoral méditerranéen, il y a un émetteur situé dans le Var sur la commune de la Garde. Ses heures d'émission sont les suivantes :

Emetteur de la Garde				
En heures d'hiver			En heures d'été	
490kHz en français	518kHz en anglais		490kHz en français	518kHz en anglais
4h00			5h00	
8h00	8h40		9h00	9h40
12h00	12h40		13h00	13h40
16h00	16h40		17h00	17h40
20h00	20h40		21h00	21h40
24h00	24h40		1h00	1h40

- ✓ Le récepteur NAVTEX NX-300 permet le réception et la visualisation des messages sur une des fréquence (490kHz ou 518kHz) préalablement sélectionnée. Il dispose d'une mémoire interne pouvant sauvegarder une centaine de message .

- ✓ Un ordinateur PC connecté au NX-300 permettra la sauvegarde des messages sur disque dur et/ou leur impression papier.

- ✓ Un GPS, connecté au NX-300, pourra utiliser l'afficheur comme console de visualisation des données de navigation (latitude, longitude etc..). Dans ce cas, un mode permettra la sélection de la station la plus proche de la position du bateau.

B) LE RECEPTEUR NX300

1) FICHE DE PRESENTATION ET SPECIFICATIONS

FURUNO

Economical - Paperless

NAVTEX RECEIVER

Model NX-300
(Dual frequency version)

- Reliable, uninterrupted reception of Navtex messages
- Designed for small boats and fishing vessels
- "No consumables or paper required
- Ultra clear 4.5" backlit monochrome LCD
- Compact, stylish display and antenna unit
- 28,000-character memory capacity for message storage
- Memory backup with a long life lithium battery
- Low power consumption
- NAV Data Display mode *
  * NAV sensor required
- Multi-language menu

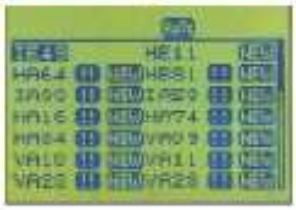
The NX-300 receives NAVTEX (Navigational Telex) messages and verifies the ID of received messages. It features two narrowband receivers, one tuned to the 518 kHz international Navtex frequency and the other to the 490 kHz domestic or local country frequency. Selection is made by a Frequency Select switch on the front panel.

NAVTEX is a worldwide coastal English language telex broadcast system. The broadcast stations transmit Navigational Warnings, Meteorological Warnings, Search and Rescue (SAR) information and other data for ships sailing within their service range. The service range is 200-400 nautical miles depending on the terrain and station transmit power; messages are broadcasted every 4 hours. The Navtex service on 490 kHz is available in the UK, France, etc. using their own language. The NX-300 features multi-language processing.

Every incoming message is identified and new messages are read on the high-contrast 4.5" LCD display; no paper is required. However, the message can be printed out via a PC interface. The broadcast station can be selected automatically according to own ship position when the NX-300 is connected with a GPS/DGPS navigator outputting position in NMEA 0183 format.

Nav Data

Message List



The NX-300 consists of a compact, waterproof display and an antenna unit. The waterproof display unit can be installed in the flybridge or at any convenient place on the vessel.

SPECIFICATIONS OF NX-300

1. **Receiver Frequencies** 518 and 490 kHz selectable on front panel key
2. **Mode of Reception** F1B
3. **Sensitivity** 2 µV e.m.f. (50 ohm), 4 % error rate
4. **Message Category**
   A: Navigational warning, B: Meteorological warning, C: Ice report, D: Search and rescue information/piracy and armed robbery, E: Meteorological forecast, F: Pilot message, G: Decca message, H: Loran-C message, I: Omega message, J: Differential omega message, K: Other electronic navigational aid and system message, L: Navigational warning (additional), M toY: Reserve - presently not used, Z: QRU (no message on hand)
1. **Display** 4.5" (95 x 60 mm) Monochrome LCD, 120 x 64 pixels
2. **Display Modes** Message Selection Mode, NAV Data Mode, Message Display Mode
3. **Message Storage** 28,000 Characters
4. **Languages** Menu in English, Spanish, German, French, Italian, Danish, Dutch, Portuguese

ENVIRONMENT (IEC 60945 test method)

Temperature

Display unit:	-15°C to +55°C
Antenna unit:	-25°C to +70°C

Waterproofing

Display unit:	IPX5 (IEC 60529), CFR-46 (USCG)
Antenna unit:	IPX6 (IEC 60529)

POWER SUPPLY

12 - 24 VDC, 1.7 W max

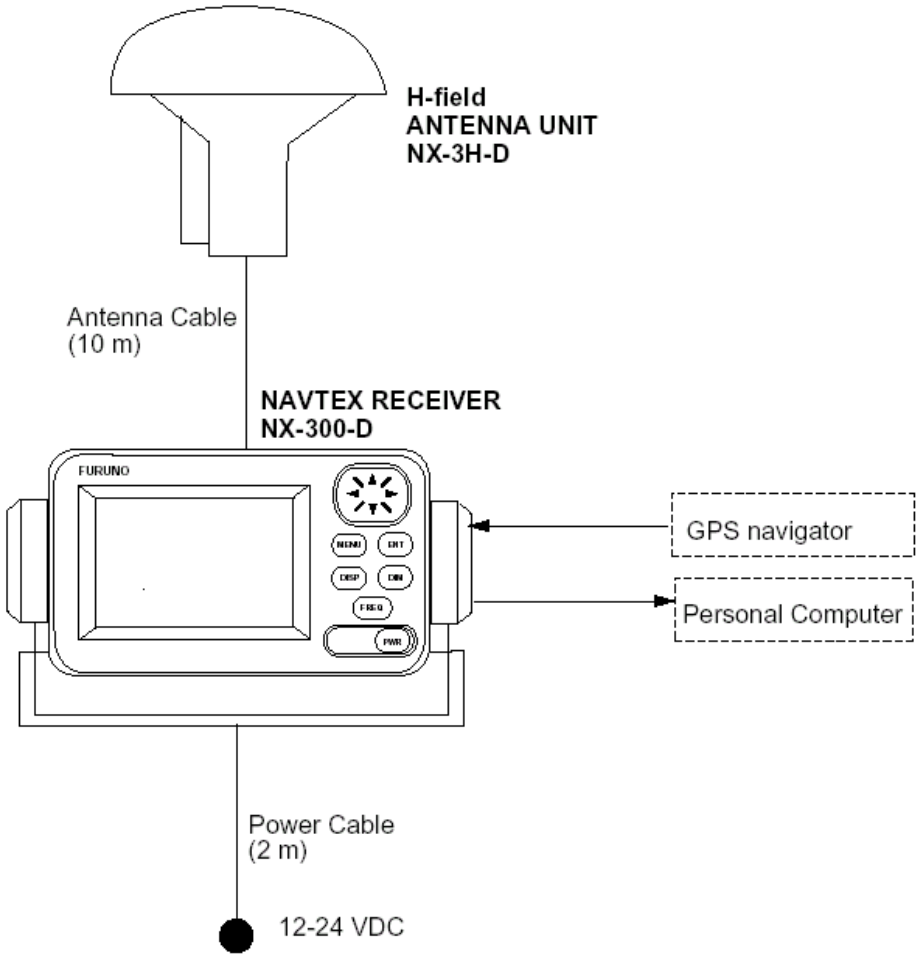
EQUIPMENT LIST

Standard

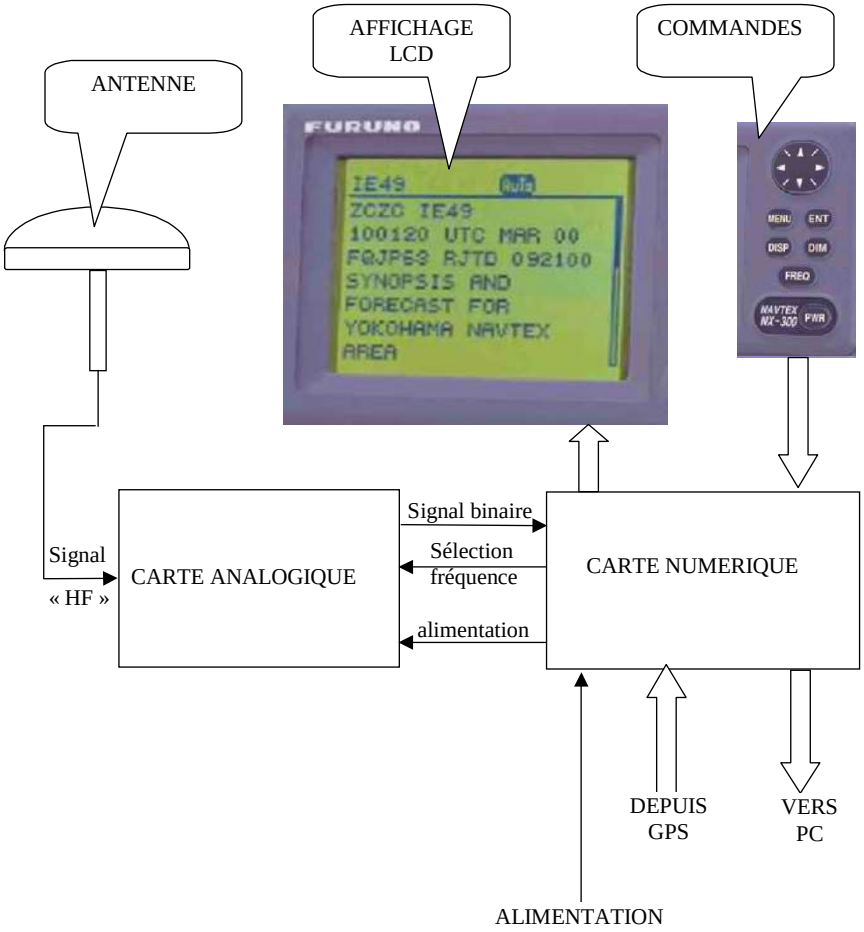
1. Display unit NX-300-D	1 unit
2. Antenna unit NX-3H-D with 10 m cable	1 unit
3. Installation materials and spare parts	1 unit

Option

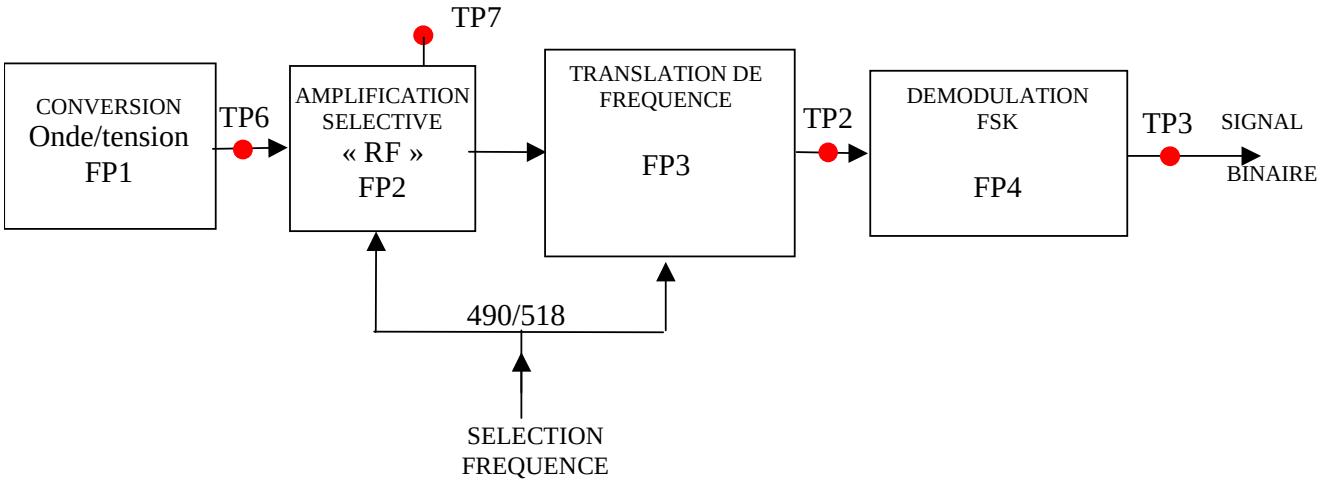
1. Flush mount kit
   OP20-29 (F type) or OP20-17 (S type)
2. Antenna base
   NO.13-QA330, NO.13QA310, NO.13-RC5160 or CP-20-01111



2) SCHEMA MODULAIRE DU RECEPTEUR NAVTEX NX-300



3) PRESENTATION FONCTIONNELLE DE DEGRE 1 DE LA PARTIE ANALOGIQUE



Le message envoyé est codé en binaire et module l'émetteur de puissance en FSK (modulation par décalage de fréquence). Le débit binaire est de 100 bits/seconde. La trame d'émission d'un message est définie précisément dans « les extraits des documents officiels » ci-joint.

Rôle de FP1 : CONVERSION ONDE/TENSION (ANTENNE)

L'antenne FP1 existe sous deux modèles.

- Antenne NX-3E : Ce premier modèle permet la détection de la composante électrique du signal. Elle est constituée d'un brin conducteur associé à un amplificateur sélectif à transistors.
- Antenne NX-3H :Ce deuxième modèle permet la détection de la composante magnétique du signal. Elle est constituée de bobinage(s). Ces bobinages étant accordés à l'aide de condensateurs aux voisinage de 500KHz. Ce modèle est généralement le plus utilisé.

Rôle de FP2 :AMPLIFICATION SELECTIVE RF GRAND GAIN

Il s'agit d'amplifier uniquement les signaux dans une bande de fréquence réduite autour de la fréquence sélectionnée par l'utilisateur.
Le signal logique 490/518 vient sélectionner la fréquence centrale du filtre.

Rôle de FP3 :TRANSLATION DE FREQUENCE

Si la fréquence 518KHz est sélectionnée

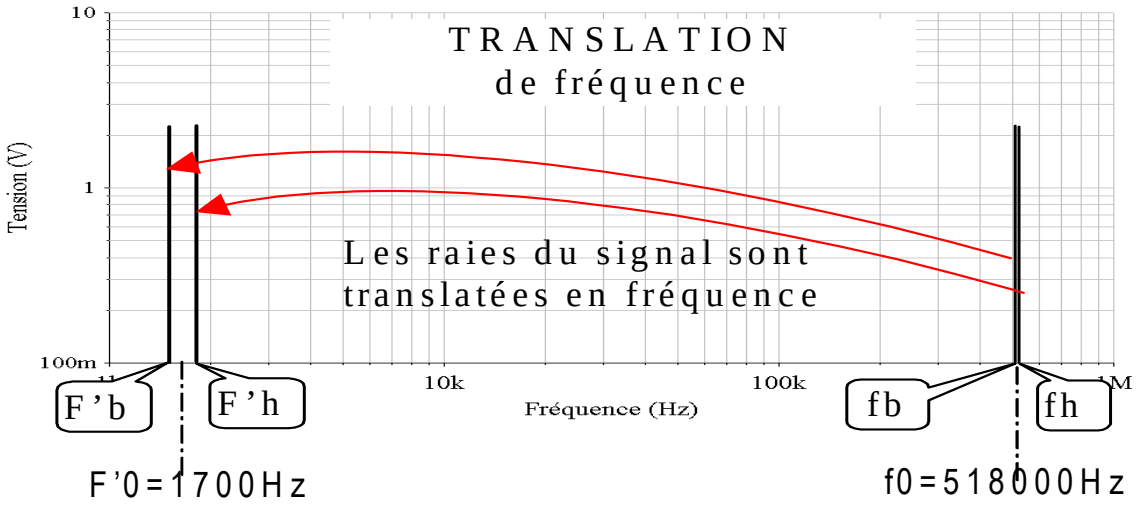
–Pour un niveau logique haut :On retrouve en sortie un signal sinusoïdal à la fréquence : fh :518000+ 170 =518170Hz

–Pour un niveau logique bas. On retrouve en sortie un signal sinusoïdal à la fréquence :fb=518000 -170= 517830Hz

L'écart relatif n'est que de $\pm 170/518000 \approx \pm 0{,}03$ % !!
Il est difficile de détecter de si petites variations relatives de fréquences.

Pour augmenter cet écart relatif on a recours à la translation de fréquence. Le principe utilisé consiste à effectuer un changement de fréquence de façon à ramener le signal à une fréquence de l'ordre de quelques kHz. L'écart entre les deux fréquences sera toujours de 170Hz mais autour d'une fréquence beaucoup plus faible. L'écart relatif sera donc beaucoup élevé et facile à détecter.

Dans le cas du NX-300 la translation de fréquence ramène la fréquence du signal à 1,7kHz , l'écart relatif sera de $\pm 170/1700 = \pm 10\%$, donc bien plus facile à détecter.

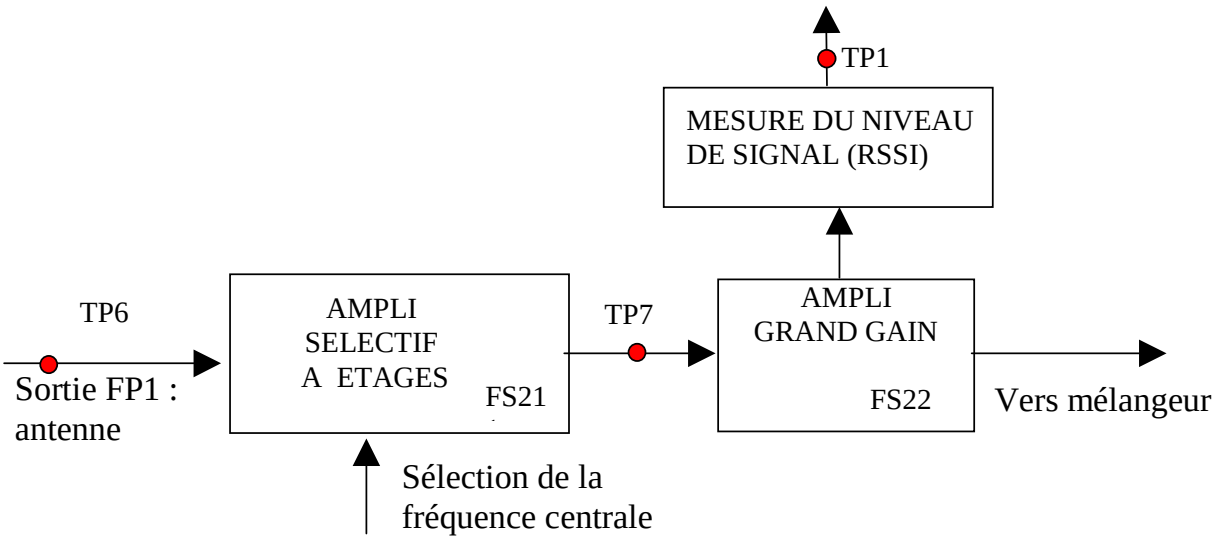


<u>Rôle de FP4 : DEMODULATION FSK</u>

Cette fonction a pour but de délivrer un niveau logique 1 lorsque le signal présent à son entrée vaut F'h=1870Hz et un niveau logique 0 lorsque sa fréquence est de F'b=1530Hz.

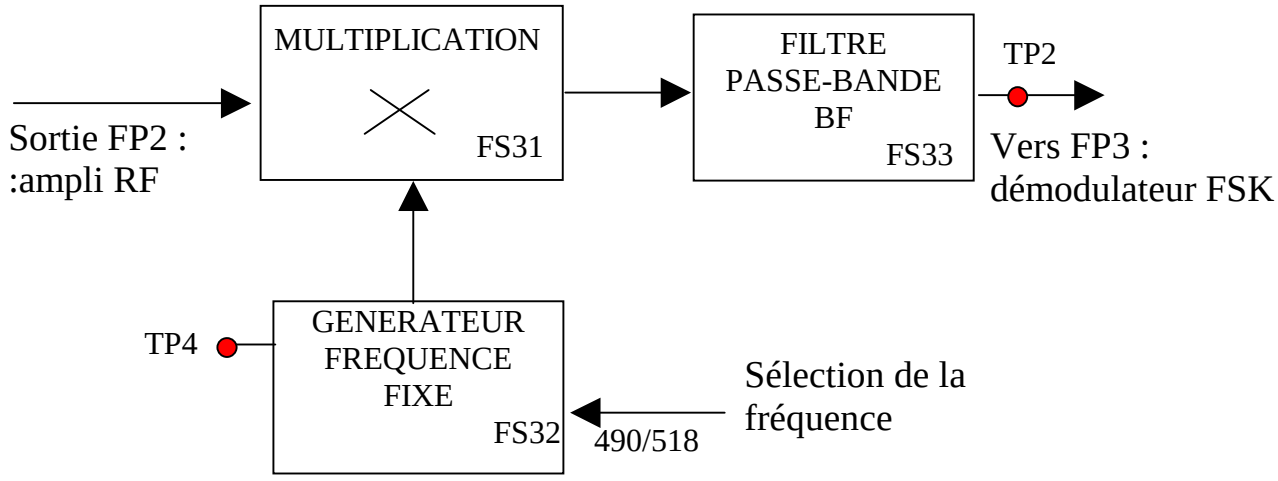
4) SCHEMAS FONCTIONNELS DE DEGRE 2 DE LA PARTIE ANALOGIQUE

FONCTION FP2 : AMPLI SELECTIF GRAND GAIN



(RSSI :Received Signal Strength Indicator)

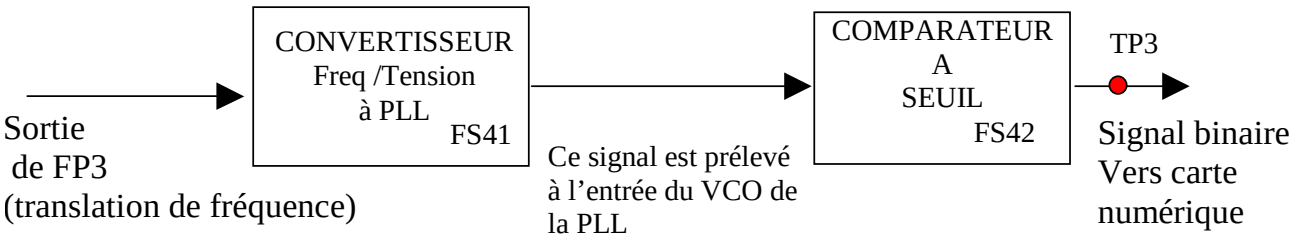
FONCTION FP3 : TRANSLATION DE FREQUENCE



Soit f, la fréquence du signal en sortie de l'ampli-sélectif FP2.
Soit fl, la fréquence du « générateur de fréquence fixe » (fréquence locale).
Le multiplicateur délivre deux composantes aux fréquences (f-fl) et (f+fl)., dont les amplitudes sont proportionnelles à celle du signal.
Le filtre passe-bande BF sert à sélectionner la composante à (f-fl). On a bien réalisé une translation de fréquence de valeur fl.
Dans le cas du récepteur NX-300 :

- La fréquence locale peut prendre comme valeur 516300Hz
- Le spectre du signal NAVTEX localisé autour de 518KHz sera donc translaté de 516300Hz, donc autour de 518000 – 516300=1700Hz.
- Le passe-bande a donc sa fréquence centrale à 1700Hz.

FONCTION FP4 : DEMODULATION FSK



La conversion fréquence/tension est réalisée à l'aide d'une boucle à verrouillage de phase (PLL).

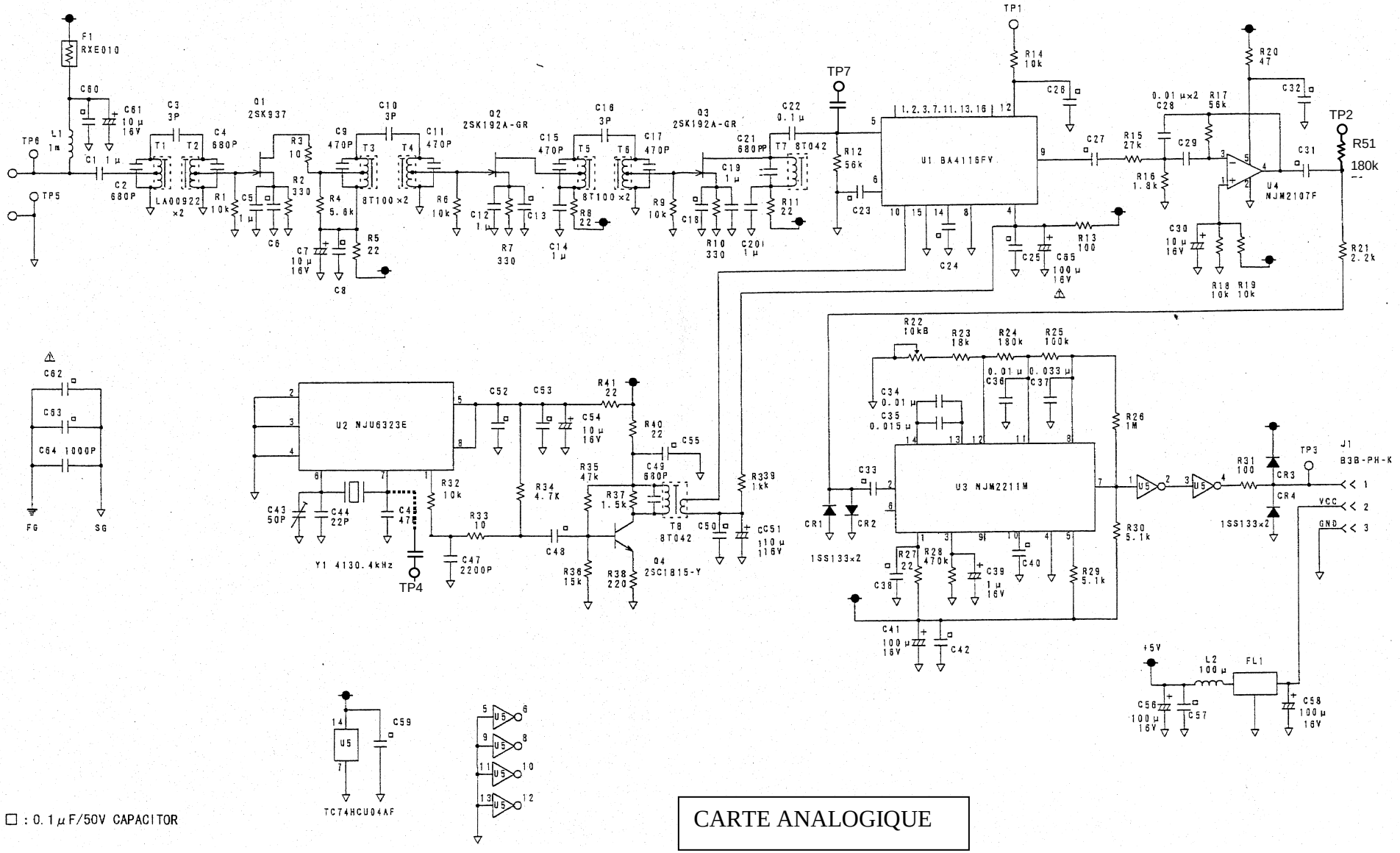
C) SCHEMAS STRUCTURELS

1) Carte Analogique

2) Alimentation & Interface RS232

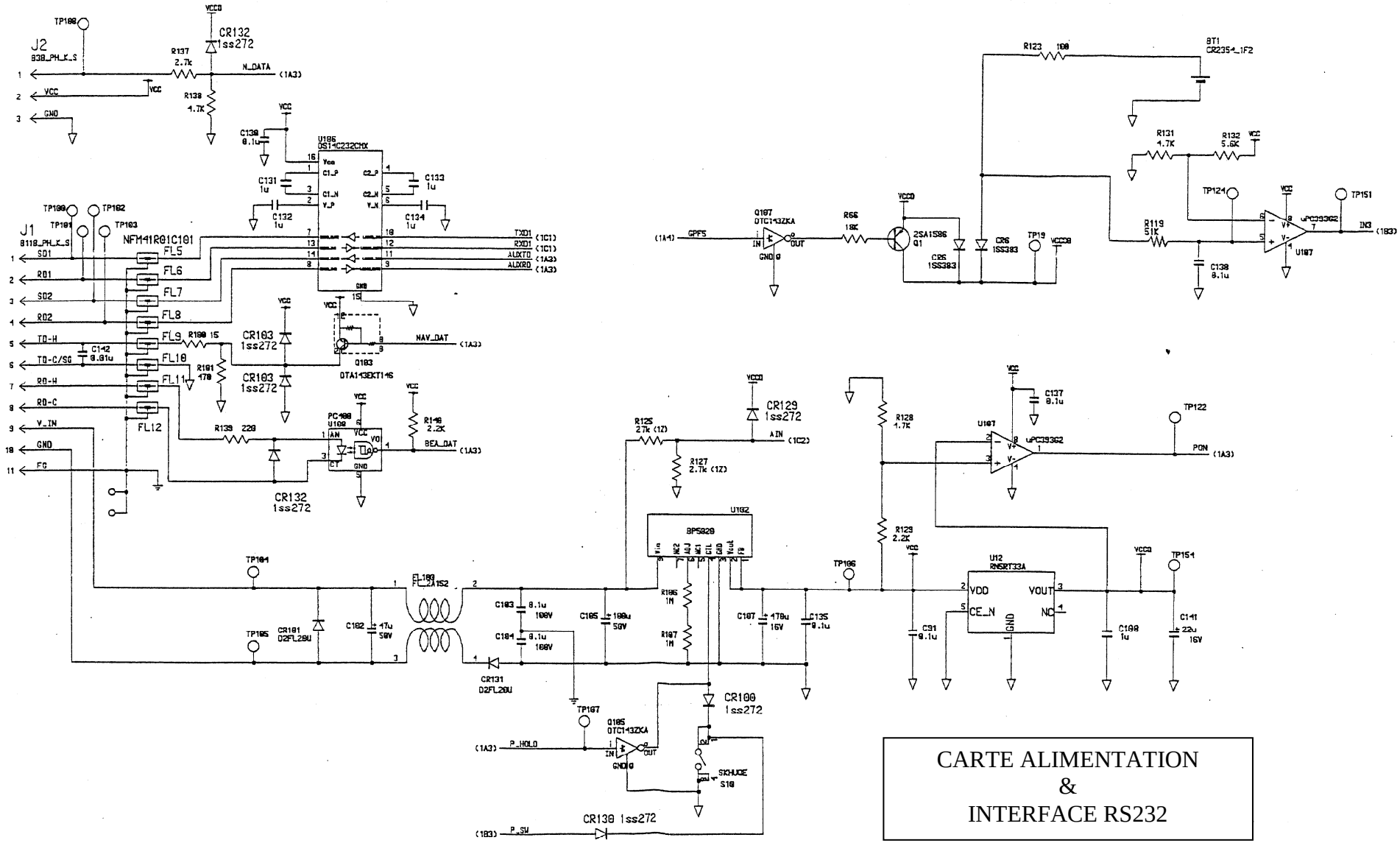
3) Carte Numérique

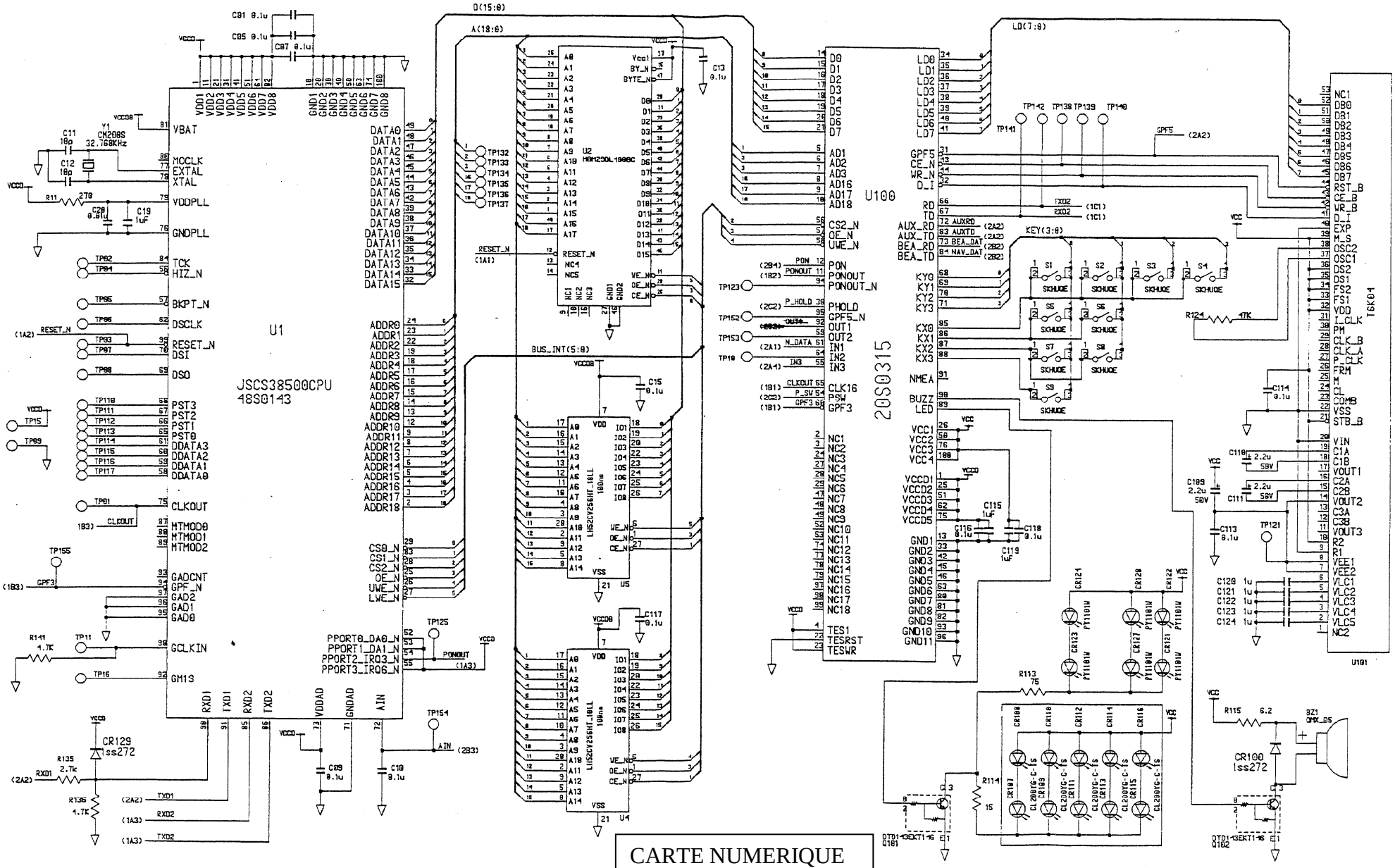
appareil ouvert



□ : 0.1µF/50V CAPACITOR

CARTE ANALOGIQUE

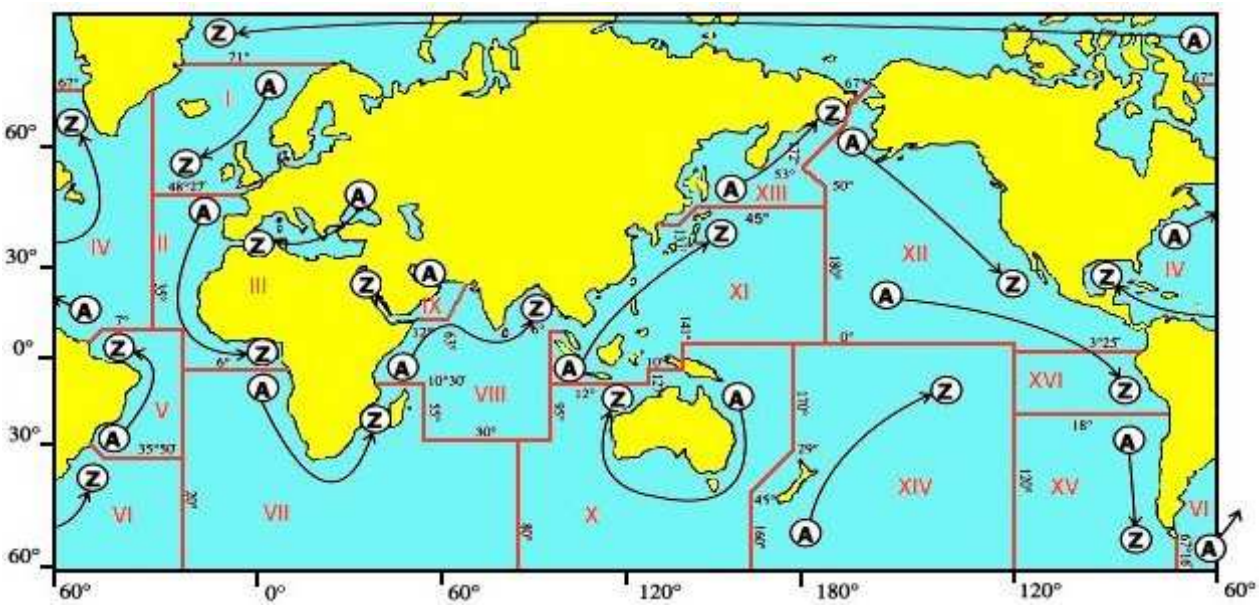

J2
J1
CR132
1ss272
CR103
1ss272
CR129
1ss272
CR131
D2FL20U
CR100
1ss272
CR130 1ss272
CR132
1ss272
CR181
D2FL20U
U105
DS1C232CMX
U107
BPS029
U12
RN5RT33A
Q107
DTC143ZKA
Q105
DTC143ZKA
Q103
DTA143EKT146
2SA1586
Q1
BT1
CR2354_1F2
FL1
FL2
FL3
FL4
FL5
FL6
FL7
FL8
FL9
FL10
FL11
FL12
NFM41R01C101
SKHUQE
S10
TXD1 (1C1)
RXD1 (1C1)
AUXTO (1A3)
AUXRO (1A3)
NAV_DAT (1A3)
BEA_DAT (1A3)
N_DATA (1A3)
P_HOLD (1A3)
P_SW (1B3)
GPFS (1A4)
PON (1A3)
IN3 (1B3)
CARTE ALIMENTATION
&
INTERFACE RS232


U1
JSCS38500CPU
48S0143
U100
20S0315
U2
HSM290L-1000C
LH52V256HT-10LL
T6K04
CARTE NUMERIQUE

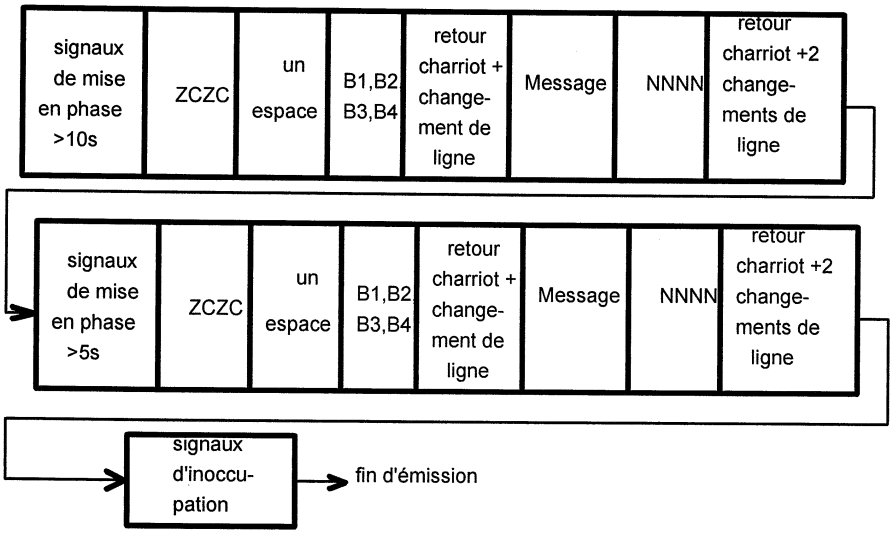
D)EXTRAITS de DOCUMENTS OFFICIELS

Documents transmis par le
Service Technique de
La Navigation Maritime et
Des Transmissions de l'Equipement

- Format technique d'un message
- Asservissements des stations
- Caractéristiques radioélectriques du NAVTEX



FORMAT TECHNIQUE D'UN MESSAGE :



signaux de mise en phase : succession de codes numériques $78 et $33 ($ indique un nombre en hexadécimal). Pour l'utilité de ces signaux, voir chapitre suivant : asservissement des stations.
ZCZC : caractères indiquant le début d'un message
B1 : caractère lettre unique attribuée à chaque émetteur (W pour Toulon La Garde), pour une zone NAVAREA. L'éloignement et la portée des émetteurs ne permettent pas de capter la même lettre de 2 zones différentes. Pour la NAVAREA III , la lettre A est attribuée à la mer Noire ,Z à Gibraltar.

B2 : lettre indiquant le sujet du message : A :avertissement de navigation ,
B :avertissement météorologique,
C : état des glaces,
D : renseignements de recherche et de sauvetage,
E : prévisions météorologiques,
F : message pour services de pilotage,
G, H,I , J et K : messages DECCA, LORAN, OMEGA, SATNAV et autres aides à la navigation,
L : avertissements identiques à A mais en surnombre (B3,B4 >99).
Les lettres B1 et B2 permettent la sélection des messages par le récepteur.
B3 et **B4** : numéro d'ordre des messages , compris entre 00 et 99. Le numéro d'ordre 00 est attribué exceptionnellement à des messages ultra prioritaires concernant la détresse.

Le message est émis en langue anglaise et comporte : la date de première diffusion, l'heure en temps universel, l'origine de l'émetteur dans la zone.
Exemples de messages captés en avril 1998 et commentaires:

```
âàâàâàâàâàâà
ZCZC WL60
141442 UTC APR 98
TTT AVURNAV TOULON NR 271/98
AZUR
FROM 160000Z TO 272359Z APR 98 SUBMARINE WORKS BY R/V NADIR IN
AREA
BOUNDED BY :
43-24.0N 007-03.0E - 43-11.7N 007-14.8E - 43-17.6N 007-26.6E -
43-30.0N 007-15.E

NNNN

ZCZC WL83
211148 UTC APR 98
TTT AVURNAV TOULON NR 295/98
CORSE
CANCEL AVURNAV TOULON 267/98
GIRAGLIA LIGHTHOUSE 4301,6N - 00924,4E LIGHT UNRELIABLE

NNNN
```

- signaux de synchro :souvent non affichés
W :Identifie Toulon La garde
A : sujet de message : avis de navigation
60 : n° d'ordre du message
diffusé le 14 Avril 98 à 14h**42**

- fin de message
- 2 changements de ligne

- message suivant

ASSERVISSEMENTS DES STATIONS

Ce chapitre concerne l'obligation de synchroniser le récepteur sur le rythme de l'émetteur , afin qu'il n'y ait pas de perte de caractères ou impression de caractères erronés.

cf : Recommandation UIT-R M 476-4 qui donne dans son annexe les caractéristiques des systèmes de détection et de correction d'erreur pour les équipements de télégraphie à impression directe . Cette annexe décrit les caractéristiques techniques d'émission, les codes et les modes d'exploitation à utiliser dans le service mobile maritime.

Les informations suivantes constituent un résumé de cette recommandation utile pour la compréhension du NAVTEX.
On désigne par stations , les émetteurs et récepteurs à terre et sur les navires.
souligné : concerne particulièrement le NAVTEX.

L'U.I.T (Union Internationale des Télécommunication Genève ,octobre 1995) recommande :
- dans le cas où un système à détection et correction d'erreurs est utilisé ,on emploie soit un système ARQ à 7 moments soit un système à 7 moments à correction et indication intrinsèques des erreurs avec réception en diversité de temps , utilisant le même code.

- Le système **NAVTEX** utilise le mode de synchronisation (entre la station émettrice et la station réceptrice) à la fois en mode A ou ARQ (correction d'erreurs par détection et répétition) et B ou CED (correction d'erreurs sans voie de retour).

- **Mode A** : système synchrone transmettant des blocs de 3 caractères entre une station émettrice d'informations (ISS) et une station réceptrice d'informations (IRS) ces stations pouvant inverser leur rôle (émettre à tour de rôle) .
La station qui déclenche l'établissement de la communication est appelée « station maîtresse » , la station appelée devient « station asservie ». La situation est inchangée jusqu'à émission d'un signal de commande , qui inverse le rôle des stations.
Remarque : une station sur un navire ne peut pas émettre , elle n'est que réceptrice d'ou nécessité de compléter par le mode B.

- **Mode B** :correction d'erreurs sans voie de retour . C'est un système synchrone transmettant un train ininterrompu de caractères d'une station émettrice en mode B collectif (CBSS) vers plusieurs stations réceptrices en mode B collectif (CBRS) ou d'une station émettrice en mode B sélectif (SBSS) vers une station particulière recevant en mode B sélectif (SBRS)

- La **station émettrice en mode B collectif** ou sélectif (CBSS ou SBSS) émet chaque caractère 2 fois , la première émission (DX) d'un caractère est suivie par l'émission de 4 autres caractères ,après quoi a lieu la retransmission (RX) du premier caractère, ce qui permet une diversité dans le temps avec un intervalle de 280ms .
Remarque : un caractère dure 70ms . Donc 4 caractères durent effectivement 280 ms.

- La **station réceptrice en mode collectif** ou sélectif (CBRS ou SBRS) vérifie que l'un des 2 caractères DX ou RX ne soit pas mutilé et dans ce cas il est imprimé ou imprime un caractère d'erreur si les 2 caractères (DX et RX) sont mutilés.

- La classe d'émission est F1B ou J2B avec déplacement de fréquence de 170 Hz sur la liaison radioélectrique . En cas de déplacement de fréquence par application de signaux audiofréquences à l'entrée d'un émetteur à bande latérale unique, la fréquence centrale du spectre audiofréquence appliquée à l'émetteur doit être de 1700 Hz.

- la largeur de bande du récepteur devrait de préférence se situer entre 270 et 340 Hz.

Tableau de conversion pour les signaux d'informations

N° combinaison	lettre	chiffre	signal 7 moments émis
1	A	-	BBBYYYB
2	B	?	YBYYBBB
3	C	:	BYBBBYY
4	D	|	BBYYBYB
5	E	3	YBBYBYB
6	F		BBYBBYY
7	G		BYBYBBY
8	H		BYYBYBB
9	I	8	BYBBYYB
10	J	Bell	BBBYBYY
11	K	(	YBBBBYY
12	L	)	BYBYYBB
13	M	.	BYYBBBY
14	N	,	BYYBBYB
15	O	9	BYYYBBB
16	P	0	BYBBYBY
17	Q	1	YBBBYBY
18	R	4	BYBYBYB
19	S	'	BBYBYYB
20	T	5	YYBYBBB
21	U	7	YBBBYYB
22	V	=	YYBBBBY
23	W	2	BBBYYBY
24	X	/	YBYBBBY
25	Y	6	BBYBYBY
26	Z	+	BBYYYBB
27	retour chariot →		YYYBBBB
28	saut de ligne →		YYBBYBB
29	inversion lettre →		YBYBBYB
30	inversion chiffre →		YBBYBBY
31	espace →		YYBBBYB
32	bande perforée →		YBYBYBB

Nota : B représente la fréquence émise supérieure

Y représente la fréquence émise inférieure.

Signaux de contrôle :

Mode B	signal
mise en phase 1	BBBBYYY
mise en phase 2	YBBYYBB

E) DOCUMENTATION PARTIELLE DES COMPOSANTS

CARTE ANALOGIQUE :

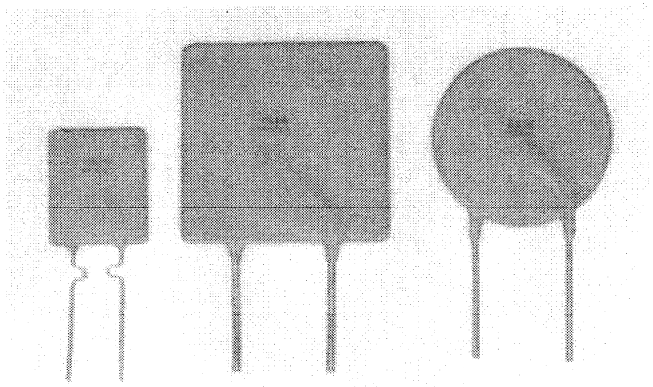
COMPOSANT	FONCTION DU COMPOSANT	page
RXE010 :	polyswitch	**Doc1**
BA4116 FV :	récepteur FM	**Doc 2**
NJM2107 :	ampli opérationnel intégré	**Doc 4**
NJM2211 :	démodulateur FSK	**Doc6**
NJU6323 :	oscillateur pour quartz	**Doc 11**
2SK192 :	transistor à effet de champ	**Doc 12**
2SK937 :	transistor à effet de champ	**Doc 14**

CARTE NUMERIQUE

COMPOSANT	FONCTION DU COMPOSANT	page
BP5220 :	régulateur à découpage	**Doc 15**
RN5RT33A :	régulateur linéaire à faible chute de tension	**Doc 16**

POLYSWICH RXE010

FUSIBLES REARMABLES



Les Polyswitch sont des fusibles électroniques réarmables qui protègent votre circuit sans besoin de remplacement. Le nombre de réarmement est illimité. Le Polyswitch est un composant résistif à coefficient de température ohmique positif. Sa valeur ohmique augmente (circuit ouvert) rapidement sous l'effet d'un accroissement de la température (à 110° sa résistance augmente brutalement) ou du courant (augmentation de la t°). Le retour à l'état d'origine (circuit fermé) ne s'effectue qu'après coupure de la source d'alimentation. Le composant se refroidi et retrouve sa faible valeur ohmique. Ainsi dans bien des cas et en fonction de ses caractéristiques, le Polyswitch peut remplacer avantageusement un fusible classique.

Pour faire votre choix, il convient de le sélectionner en fonction de ses trois principaux paramètres:

. Le **courant de maintien**.

. Le **courant de basculement**.

. La **tension maximale** d'utilisation. (point faible par rapport à un fusible classique)

Par exemple, le **RXE010** a un courant de maintien de **100mA**, un courant de basculement de **200mA** et une tension max. de **60V**

DOC 1

Tyco/Electronics
Raychem Circuit Protection
308 Constitution Drive
Menlo Park, CA 94025-1164
Phone: 800-227-4856
Fax: 800-227-4866

PolySwitch®
PTC Devices
Overcurrent Protection Device

PRODUCT: RXE010
DOCUMENT: SCD 22156
PCN: 838429
REV LETTER: I
REV DATE: FEBRUARY 7, 2002
PAGE NO.: 1 OF 1

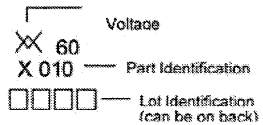
Specification Status: RELEASED

Electrical Rating
Voltage: 60V MAX
Current: 40A MAX

Insulating Material:
Cured, Flame Retarded Epoxy Polymer
meets UL94 V-0 Requirements

Lead Material:
24 AWG, Solder coated Nickel- Copper alloy

Marking:



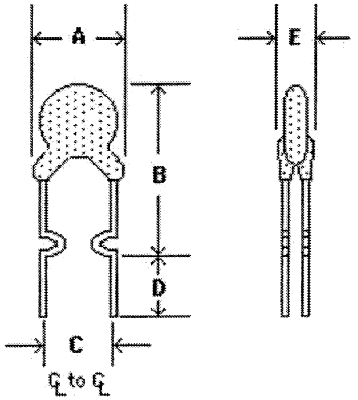


TABLE I. DIMENSIONS:

	A		B		C		D		E		F
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
mm:	--	7.4	--	11.6	4.3	5.8	7.6	--	--	3.0	--
in*:	--	(0.29)	--	(0.46)	(0.17)	(0.23)	(0.30)	--	--	(0.12)	--

*Rounded off approximation

TABLE II. PERFORMANCE RATINGS:

I_H RATED CURRENT	CURRENT RATINGS						TIME TO TRIP	INITIAL RESISTANCE VALUES		ONE-HOUR POST-TRIP RESISTANCE STANDARD TRIP	NOMINAL TRIPPED-STATE POWER DISSIPATION
AMPERES 20°C HOLD	AMPERES AT 0°C		AMPERES AT 20°C		AMPERES AT 60°C		SECONDS AT 20°C, 0.5A	OHMS AT 20°C		OHMS AT 20°C	WATTS AT 20°C
	HOLD	TRIP	HOLD	TRIP	HOLD	TRIP	MAX	MIN	MAX	MAX	NOMINAL
.10	.11	.22	.10	.20	.07	.14	4.0	2.50	4.50	7.5	0.38

Recognitions: UL, CSA and TUV approved.
Approved by UL as a current limiting impedance, per the 1996 NEC, Tables 11 (c) and 11 (b).
Reference Documents: PS300
Precedence: This specification takes precedence over documents referenced herein.
Effectivity: Reference documents shall be the issue in effect on the date of invitation for bid.
CAUTION: Operation beyond the rated voltage or current may result in rupture, electrical arcing or flame.

FM IF detector for cordless phones

BA4116FV

The BA4116FV is an IC with mixing circuit, IF circuit, FM detector circuit, RSSI circuit, and noise detector circuit. As it can operate at low voltages, it is ideal for use in cordless phones.

●Applications

Cordless phones, amateur short wave radios, and other portable wireless equipment

●Features

1) Input frequencies of 10MHz to 150MHz can be accommodated.
2) Low-voltage operation. (1.8 to 5.5V)
3) Excellent temperature characteristic.
4) High sensitivity; 12dB SINAD sensitivity = 8dBμVEMF (50 Ω)
5) High intercept point. (–11dBm)
6) Small package used. (0.65mm pitch)

●Absolute maximum ratings (Ta = 25°C)

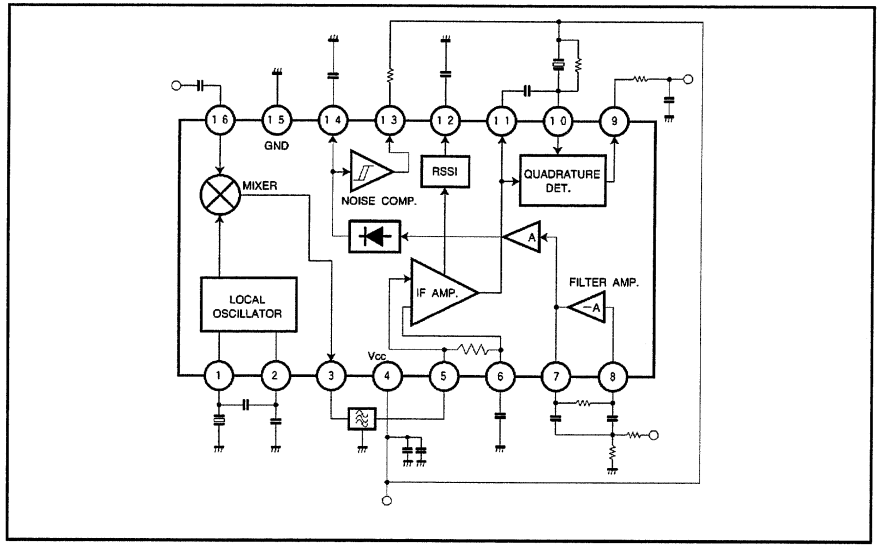
Parameter	Symbol	Limits	Unit
Power supply voltage	Vcc	7.0	V
Power dissipation	Pd	350*	mW
Operating temperature	Topr	−30~+85	℃
Storage temperature	Tstg	−55~+125	℃

* Reduced by 3.5mW for each increase in Ta of 1℃ over 25℃.

●Recommended operating conditions (Ta = 25°C)

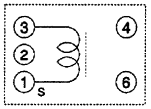
Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	Vcc	1.8	2.0	5.5	V

●Block diagram



DOC 2

●Attached components

Part No.	Part name	Prod. No./Mfg.	Notes
CF1	Ceramic filter	Murata: CFWM450G	6 dB band width = ±4.5 kHz min. Attenuation band width = ± 10 kHz max. Guaranteed attenuation= 35 dB min. Input loss = 6 dB max.
CD1	Ceramic discriminator	Murata: CDB450C24	
L1	Wave detection coil	Toko: 5PNR-2876Z	 1–3 190T Wire type: 0.045ø, 3UEW L variable range= ±4 % Q at no load = 20 min.

●Determining the filter amplifier constant (multi-layer recovery band pass filter)

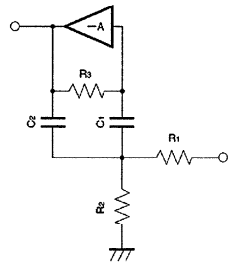


Fig. 3

f_0: Center frequency
Q: Center frequency f_0/band width BW
A_0: I/O gain

The reference resistance R_0 is determined as $C_1 = C_2 = C_0$.

$R_0 = 1/2\pi f_0 \cdot C_0$

$R_1 = R_0 \cdot Q/A_0$

$R_2 = R_0/[2Q - (A_0/Q)]$

$R_3 = 2R_0 \cdot Q$

The Filter gain can be adjusted by varying R_1, but with the $A_0 > 1$ design, please be aware that influence from the open loop characteristic of the amplifier causes offset in the center frequency f_0.

●Electrical characteristic curves

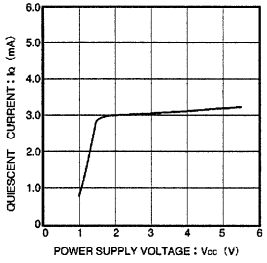


Fig. 4 Quiescent current vs. power supply voltage

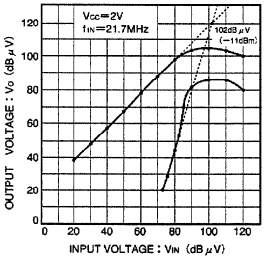


Fig. 5 Mixer output voltage vs. input voltage

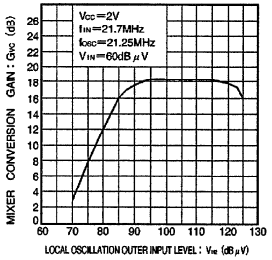


Fig. 6 Mixer conversion gain vs. Pin 2 OSC injection level

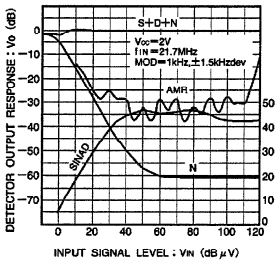


Fig. 7 Detector output response, AMR, SINAD vs. input signal level

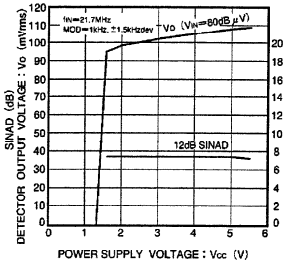


Fig. 8 Detector output voltage, 12 dB SINAD sensitivity vs. power supply voltage

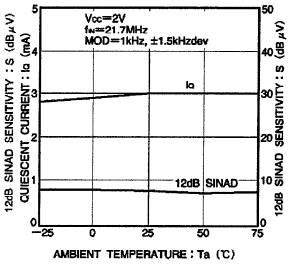


Fig. 9 Quiescent current, 12 dB SINAD sensitivity vs. ambient temperature

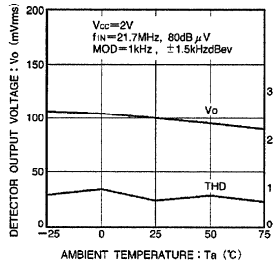


Fig. 10 Detector output level, THD vs. ambient temperature

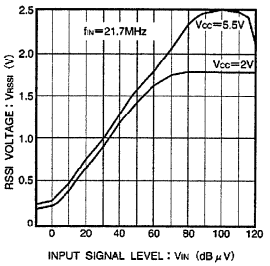


Fig. 11 RSSI voltage vs. input signal level

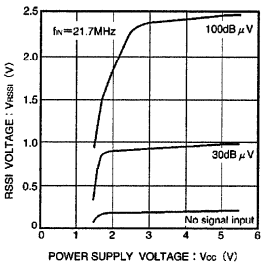


Fig. 12 RSSI voltage vs. power supply voltage

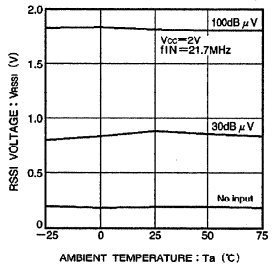


Fig. 13 RSSI voltage vs. ambient temperature

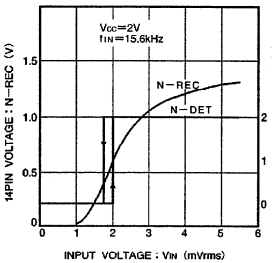


Fig. 14 Pin 13 voltage, Pin 14 voltage vs. noise amplifier input voltage

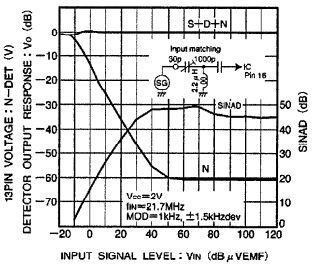


Fig. 15 Detector output response, SINAD vs. input signal level

DOC3

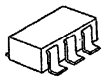
SINGLE OPERATIONAL AMPLIFIER

■ GENERAL DESCRIPTION

NJM 2107F is a single operational amplifier of ultra miniature surface mount package.

NJM 2107F has features of low operating supply voltage and low saturation output voltage. The NJM2107F is suitable for small electronic equipments and hybrid circuits.

■ PACKAGE OUTLINE

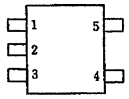


NJM2107F

■ FEATURE

- Operating Voltage (V^+/V^-=±1.0V to ±3.5V)
- Low Output Saturation : $4V_{P-P}$ at single 5V supply
- V Shield Plate between +Input and -Intput
- Suitable Pin Arrangement for Application
- Mounted in Ultra Miniature 2.9×1.5mm : (1/5 of DMP-8 package)
- Bipolar Technology

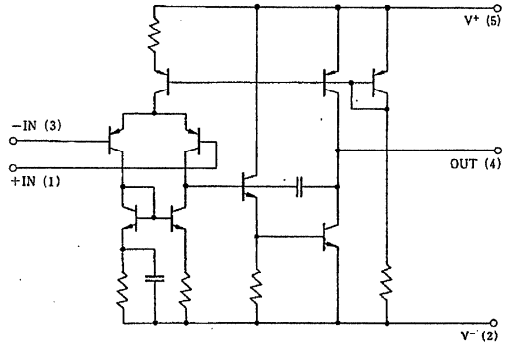
■ PIN CONFIGURATION



NJM2107F

Pin Function
1. +INPUT
2. V⁻
3. −INPUT
4. OUTPUT
5. V⁺

■ EQUIVALENT CIRCUIT



■ ABSOLUTE MAXIMUM RATINGS (Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+/V^-	±3.5	V
Differential Input Voltage	V_{ID}	±7	V
Input Voltage	V_{IC}	±3.5	V
Power Dissipation	P_D	200	mW
Operating Temperature Range	T_{opr}	−40~+85	℃
Storage Temperature Range	T_{stg}	−40~+125	℃

■ ELECTRICAL CHARACTERISTICS (V^+/V^-=±2.5V, Ta=25℃)

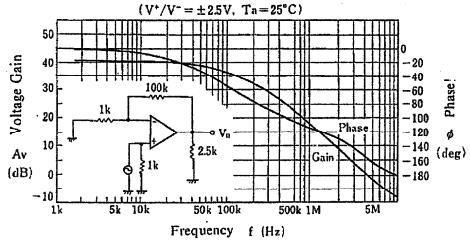
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Offset Voltage	V_{IO}	R_S=10kΩ	−	1	6	mV
Input Offset Current	I_{IO}	I^+-I^-	−	5	200	nA
Input Bias Current	I_B		−	100	500	nA
Input Common Mode Voltage Range	V_{ICM}		±1.5	−	−	V
Large Signal Voltage Gain	A_V	R_L=10kΩ, V_O=±2.0V	60	80	−	dB
Output Voltage Swing	V_{OM}	R_L=2.5kΩ	±2.0	±2.2	−	V
Common Mode Rejection Ratio	CMR	R_S≦10kΩ	60	80	−	dB
Supply Voltage Rejection Ratio	SVR	R_S≦10KΩ	60	70	−	dB
Slew Rate	SR	V_{IN}=±1V_{P-P}, A_{CL}=+1	−	3	−	V/μs
Operating Current	I_{CC}		1	2	3	mA

DOC4

■ TYPICAL CHARACTERISTICS

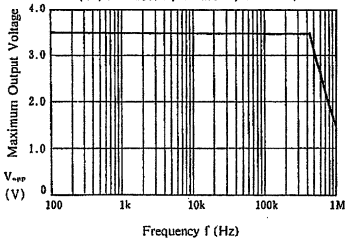
Voltage Gain, Phase vs. Frequency

(V+/V− = ±2.5V, Ta=25°C)



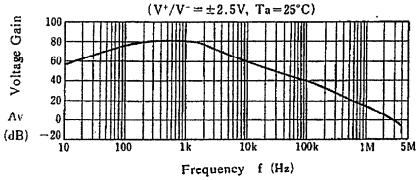
Maximum Output Voltage vs. Frequency

(V+/V− = ±2.5V, R=2.5kΩ, Ta=25°C)

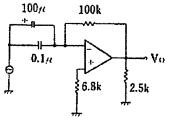


Voltage Gain, vs. Frequency

(V+/V− = ±2.5V, Ta=25°C)

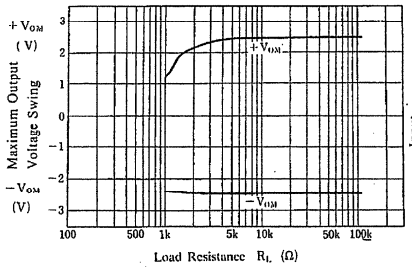


Test Circuit



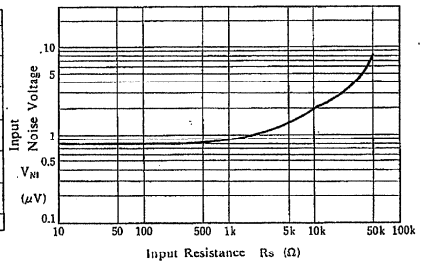
Maximum Output Voltage Swing vs. Load Resistance

(V+/V− = ±2.5 V, Ta = 25°C)



Input Noise Voltage vs. Input Resistance

(V+/V− = ±3.0 V, Ta = 25°C)

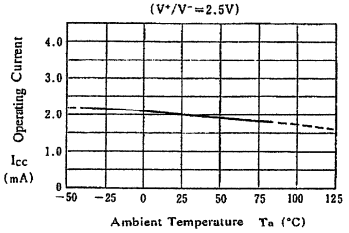


DOC 5

■ TYPICAL CHARACTERISTICS

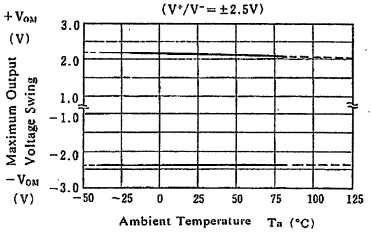
Operating Current vs. Temperature

(V+/V− = 2.5V)



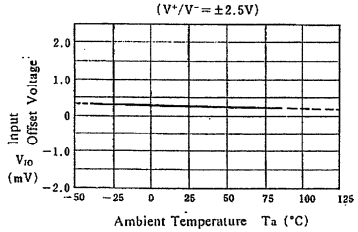
Maximum Output Voltage Swing vs. Temperature

(V+/V− = ±2.5V)



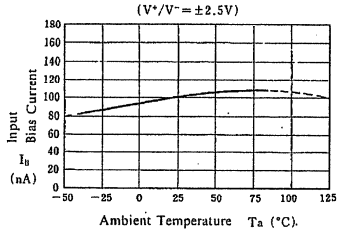
Input Offset Voltage vs. Temperatre

(V+/V− = ±2.5V)



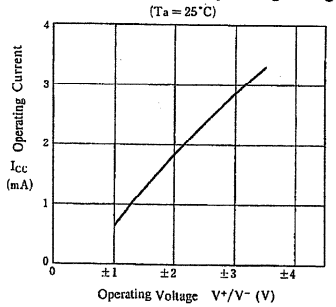
Input Bias Current vs. Temperature

(V+/V− = ±2.5V)



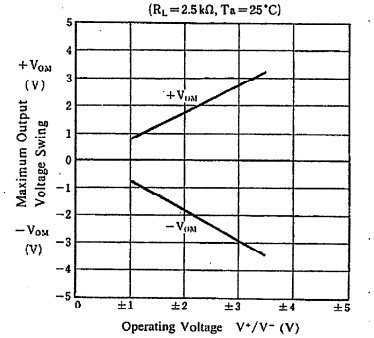
Operating Current vs. Operating Voltage

(Ta = 25°C)



Maximum Output Voltage Swing vs. Operating Voltage

(RL=2.5kΩ, Ta=25°C)



FSK DEMODULATOR / TONE DECODER

■ GENERAL DESCRIPTION

The **NJM2211** is a monolithic phase-locked loop (PLL) system especially designed for data communications. It is particularly well suited for FSK modem applications, and operates over a wide frequency range of 0.01Hz to 300kHz. It can accommodate analog signals between 2mV and 3V, and can interface with conventional DTL, TTL and ECL logic families. The circuit consists of a basic PLL for tracking an input signal frequency within the passband, a quadrature phase detector which provides carrier detection, and an FSK voltage comparator which provides FSK demodulation. External components are used to independently set carrier frequency, bandwidth, and output delay.

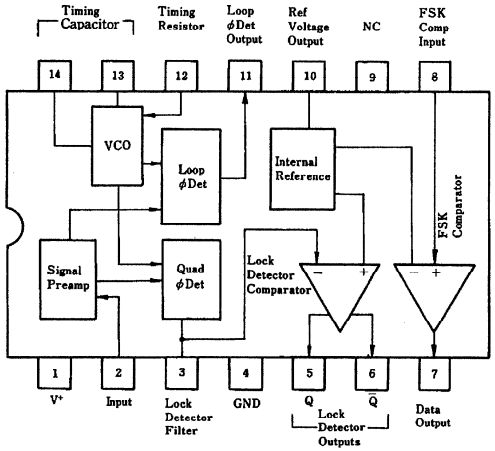
■ FEATURES

- Wide Operating Voltage (4.5V to 20V)
- Wide frequency range (0.01Hz to 300kHz)
- DTL / TTL / ECL logic compatibility
- FSK demodulation with carrier-detector
- Wide dynamic range (2mV to 3V_{rms})
- Adjustable tracking range (±1% to ±80%)
- Excellent temperature stability (20ppm / °C typical)
- Package Outline DIP14, DMP14
- Bipolar Technology

■ APPLICATIONS

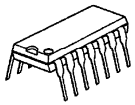
- FSK demodulation
- Data synchronization
- Tone decoding
- FM detection
- Carrier detection

■ PIN CONFIGURATION

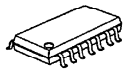


NJM2211D
NJM2211M

■ PACKAGE OUTLINE



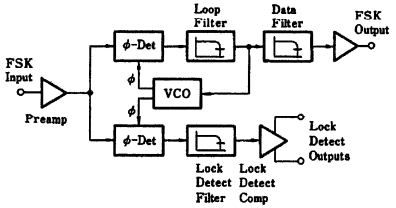
NJM2211D



NJM2211M

NJM2211

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	20	V
Input Signal Level	V_{IN}	3	Vrms
Power Dissipation	P_D	(DIP14) 700	mW
		(DMP14) 300	mW
Operating Temperature Range	T_{opr}	-40 to +85	°C
Storage Temperature Range	T_{stg}	-40 to +125	°C

DOC6

■ ELECTRICAL CHARACTERISTICS

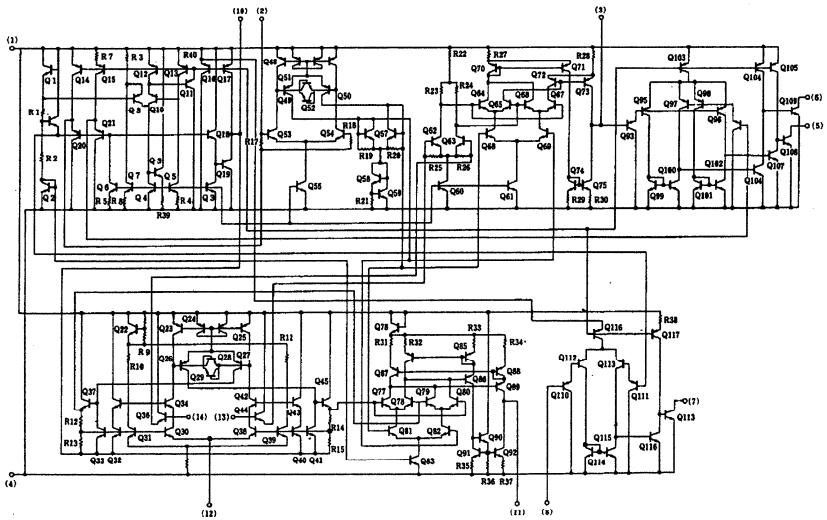
(V^+=+12V, T_a=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V^+		4.5	-	20	V
Operating Current	I_{CC}	$R_0 \geq 10k\Omega$	-	5	11	mA
Oscillator						
Frequency Accuracy	Δf_0		-	±1.0	-	%
Frequency Stability Temp. Coefficient	$\Delta f_0 / \Delta T$	$R_1=\infty$	-	±20	-	ppm / °C
Power Supply Rejection	PSRR	V^+=12±1V V^+=5±0.5V	-	±0.05 ±0.2	±1.5	% / V % / V
Upper Frequency Limit	$f_{0\,MAX}$	R_0=8.2kΩ, C_0=400pF	-	300	-	kHz
Lowest Operating Frequency	$f_{0\,MIN}$	R_0=2MΩ, C_0=50μF	-	0.01	-	Hz
Timing Resistor						
Timing Resistor	R_0	Operating Range	5	-	2000	kΩ
		Recommended Range	15	-	100	kΩ
Loop Phase Detector						
Peak Output Current	I_0	Meas. at pin 11	±100	±200	±300	μA
Output Offset Current	I_{OS}		-	±2.0	-	μA
Output Impedance	Z_0		-	1.0	-	MΩ
Maximum Voltage Swing	V_{OM}	Ref. to pin 10	±4.0	±5.0	-	V
Quadrature Phase Detector						
Peak Output Current	I_O	Meas. at Pin 3	-	150	-	μA
Output Impedance			-	1.0	-	MΩ
Maximum Voltage Swing			-	11	-	V_{P-P}
Input Preamp						
Input Impedance	R_{IN}	Meas. at Pin 2	-	20	-	kΩ
Input Signal Voltage Required to Cause Limiting	V_{IN}		-	2	-	mVrms
Voltage Comparator						
Input Impedance	R_{IN}	Measure at Pin 3 & 8	-	2	-	MΩ
Input Bias Current	I_B		-	100	-	nA
Voltage Gain	G_V	R_L=5.1kΩ	-	70	-	dB
Output Voltage Low	V_{SAT}	5, 6, 7_{PIN} I_C=3mA	-	0.3	1.0	V
Output Leakage Current	I_{LEAK}	V_0=12V	-	0.01	11	μA
Internal Reference						
Output Voltage	V_{REF}	Measure at Pin 10	4.75	5.30	5.85	V
Output Impedance	Z_0		-	100	-	Ω

DOC7

NJM2211

■ EQUIVALENT CIRCUIT



■ CIRCUIT FUNCTION

• Signal Input (Pin 2)

The input signal is AC coupled to this terminal. The internal impedance at pin 2 is 20kΩ, Recommended input signal leveles in the range of 10mVrms to 3Vrms.

• Quadrature Phase Detector Output (Pin 3)

This is the high-impedance output of the quadrature phase detector, and is internally connected to the input of lock-detect voltage comparator. In tone detection applications, pin 3 is connected to ground through a parallel combination of R_D and C_D (see Figure 1) to eliminate chatter at the lock-detect outputs. If this tone-detect section is not used, pin 3 can be left open circuited.

• Lock-Detect Output, Q (Pin 5)

The output at pin 5 is at a "high" state when the PLL is out of lock and goes to a "low" or conducting state when the PLL is locked. It is an open collector type output and required a pull-up resistor, R_L, to V^+ for proper operation. In the "low" state it can sink up to 5mA of load current.

• Lock-Detect Complement, Q (Pin 6)

The output at pin 6 is the logic complement of the lock-detect output at pin 5. This output is also an open collector type stage which can sink 5mA of load current in the low or "on" state.

• FSK Data Output (Pin 7)

This output is an open collector logic stage which requres a pull-up resistor, R_L, to V^+ for proper operation. It can sink 5mA of load current. When decoding FSK signals the FSK data output will switch to a "high"or off state for low input frequency, and will switch to a "low" or on state for high input frequency. If no input signal is present, the logic state at pin 7 is indeterminate.

• FSK Comparator Input (Pin 8)

This is the high-impedance input to the FSK voltage comparator. Normally, an FSK post-detection or data filter is connected between this terminal and the PLL phase-detector output (pin 11). This data filter is formed by R_F and C_F of Figure 1. The threshold voltage of the comparator is set by the internal reference voltage, V_R, available at pin 10.

• Reference Voltage V_R (Pin 10)

This pin is internally biased at the reference voltage level, V_R ; V_R=V+ / 2-650mV. The DC voltage level at this pin forms an internal reference for the voltage levels at pin 3, 8, 11, and 12. Pin 10 must be bypassed to ground with a 0.1µF capacitor.

• Loop Phase Detector Output (Pin 11)

This terminal provides a high impedance output for the loop phase-detector. The PLL loop filter is formed by R1 and C1 connected to pin 11 (see Figure 1). With no input signal, or with no phase error within the PLL, the DC level at pin 11 is very nearly equal to V_{REF}. The peak voltage swing available at the phase detector output is equal to $\pm V_{REF}$.

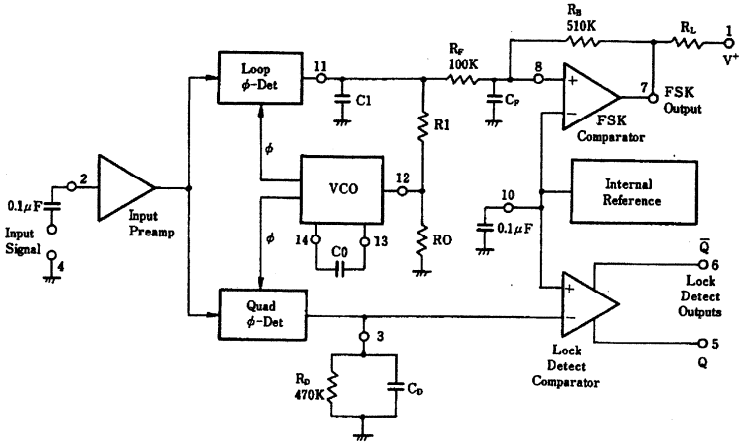


Figure 1. FSK & Tone Detection

• VCO Control Input (Pin 12)

VCO free-running frequency is determined by external timing resistor, R0, connected from this terminal to ground. The VCO free-running frequency, f_0, is given by :

$$f_0(\text{Hz}) = \frac{1}{R0C0}$$

where C0 is the timing capacitor across pins 13 and 14. For optimum temperature stability R0 must be in the range of 10kΩ to 100kΩ (see Typical Electrical Characteristics).

This terminal is a low impedance point, and is internally biased at a DC level equal to V_R. The maximum timing current drawn from pin 12 must be limited to ≤ 3mA for proper operation of the circuit.

• VCO Timing Capacitor (Pins 13 and 14)

VCO frequency is inversely proportional to the external timing capacitor, C0, connected across these terminals. C0 must be non-polarized, and in the range of 200pF to 10µF.

• VCO Frequency Adjustment

VCO can be fine tuned by connecting a potentiometer, R_X, in series with R0 at pin 12 (see Figure 2)

• VCO Free-Running Frequency, F_0

The **NJM2211** does not have a separate VCO output terminal. Instead, the VCO outputs are internally connected to the phase-detector sections of the circuit. However, for setup or adjustment purposes, the VCO free-running frequency can be measured at pin 3 (with C_D disconnected) with no input and also pin 2 shorted to pin 10.

NJM2211

■ DESIGN EQUATIONS

See Figure 1 for Definitions of Components.

1. VCO Center Frequency, f_0 :

$$f_0(\text{Hz}) = \frac{1}{R0C0}$$

2. Internal Reference Voltage, V_R (measured at pin 10) :

$$V_R = \left(\frac{+V_S}{2}\right) - 650\text{mV}$$

3. Loop Lowpass Filter Time Constant, τ :

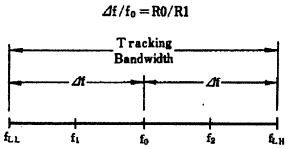
$$\tau = R1C1$$

4. Loop Damping, ξ :

$$\xi = \left(\sqrt{\frac{C_0}{C_1}}\right)\left(\frac{1}{4}\right)$$

5. Loop Tracking Bandwidth, $\pm\Delta f/f_0$:

$$\Delta f/f_0 = R0 / R1$$



6. FSK Date Filter Time Constant, τ_F :

$$\tau_F = R_F C_F$$

7. Loop Phase Detector Conversion Gain, K_φ :

(K_φ is the differential DC voltage across pins 10 and 11, per unit of phase error at phase-detector input) :

$$K_\varphi \text{ (in volts per radian)} = \frac{(-2)(V_{REF})}{\pi}$$

8. VCO conversion Gain, K_0, is the amount of change in VCO frequency per unit of DC voltage change at pin

$$K_0 \text{ (in Hertz per volt)} = \frac{-1}{C0R1V_{REF}}$$

9. Total Loop Gain K_T :

$$K_T \text{ (in radians per second per volt} = 2\pi K\varphi K_0 = 4 / C_0R_1$$

10. Peak Phase-Detector Current, I_A :

$$I_A(\text{mA}) = \frac{V_{REF}}{25}$$

DOC8

■ APPLICATIONS

FSK Decoding

Figure 2 shows the basic circuit connection for FSK decoding. With reference to Figures 1 and 2, the functions of external components are defined as follows : R0 and C0 set the PLL center frequency. R1 sets the system bandwidth, and C1 sets the loop filter time constant and the loop damping factor. C_F and R_F from a one pole post-detection filter for the FSK data output. The resistor R_B (=510kΩ) from pin 7 to pin 8 introduces positive feedback across FSK comparator to facilitate rapid transition between output logic states.

Recommended component values for some of the most commonly used FSK bauds are given in Table 1.

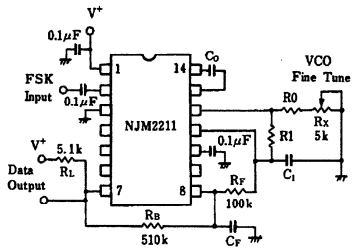


Figure 2. FSK Decoding

Table 1. Recommended Value for FSK
(Ref. Fig. 2)

FSK Band	Component Values
300 Band	C0=0.039μF C_F=0.005μF
F_1 =1070Hz	C1=0.01μF R0=18kΩ
f2 =1270Hz	R1=100kΩ
300 Band	C0=0.022μF C_F=0.005μF
f_1=2025Hz	C1=0.0047μF R0=18kΩ
f_2=2225Hz	R1=200kΩ
1200 Band	C0=0.027μF C_F=0.0022μF
f_1=1200Hz	C1=0.01μF R0=18kΩ
f_2=2200Hz	R1=30kΩ

Design Instructions

The circuit of Figure 2 can be tailored for any FSK decoding application by the choice of five key circuit components ; R0, R1, C0, C1 and CF. For a given set of FSK mark and space frequencies. f1 and f2, these parameters can be calculated as follows :

1. Calculate PLL center frequency, f_0

$$f_0 = \frac{f_1 + f_2}{2}$$

2. Chose a value of timing resistor R0 to be in the range of 10kΩ to 100kΩ. This choice is arbitary. The recommended value is R0 ≅ 20kΩ. The final value of R0 is normally fine-tuned with the series potentiometer, R_x.

3. Calculate value of C0 from Design Equation No.1 or from Typical Performance Characteristics :
   $C0 = 1 / R0 f_0$

4. Calculate R1 to give a Δf equal to the mark-space deviation :
   $R1 = R0 [f_0 / (f_1 - f_2)]$

5. Calculate C1 to set loop damping. (See Design Equation No.4.)
   Normally, ξ ≈ 1 / 2 is recommended
   Then : $C1 = C0 / 4$ for ξ = 1 / 2

6. Calculate Data Filter Capacitance, C_F :
   For R_F=100kΩ. R_B=510kΩ, the recommended value of C_F is :

$$C_F (\text{in } \mu F) = \frac{3}{\text{Band Rate}}$$

Note : All calculated component values except R0 can be rounded off to the nearest standard value, and R0 can be varied to fine-tune center frequency through a series potentiometer, R_x (see Figure 2).

DOC9

NJM2211

Design Example

75 Band FSK demodulator with mark / space frequencies of 1110 / 1170Hz :

Step 1 : Calculate f_0 :
$f_0 = (1110+1170)\ (1 / 2) = 1140Hz$

Step 2 : Choose R0=20kΩ (18kΩ fixed resistor in series with 5kΩ potentiometer)

Step 3 : Calculate C0 from VCO Frequency vs. Timing Capacitor : C0 =0.044μF

Step 4 : Calculate R1 : $R1 = R0\ (1140 / 60) = 380k\Omega$

Step 5 : Calculate C1 : $C1 = C0 / 4 = 0.011\mu F$

Note : All values except R0 can be rounded off to nearest standard value.

FSK Decoding With Carrier Detect

The lock-detect section of the **NJM2211** can be used as a carrier detect option for FSK decoding. The recommended circuit connection for this application is shown in Figure 3. The open-collector lock-detect output, pin 6, is shorted to the data output (pin 7). Thus, the data output will be disabled at "low" state, until there is a carrier within the detection band of the PLL, and the pin 6 output goes "high" to enable the data output.

The Minimum value of the lock-detect filter capacitance C_D is inversely proportional to the capture range, $\pm\Delta f_c$. This is the range of incoming frequencies over which the loop can acquire lock and is always less than the tracking range. It is further limited by C1. For most applications, $\Delta f_c < \Delta f / 2$, For R_D=470kΩ, the approximate minimum value of C_D can be determined by :

C_D (μF) ≥ 16 / capture range in Hz

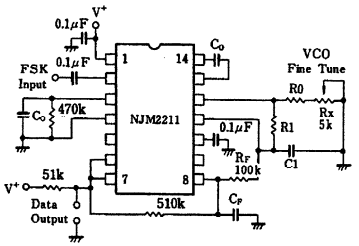
With values of C_D that are too small, chatter can be observed on the lock-detect output as an incoming signal frequency approaches the capture bandwidth. Excessively large values of C_D will slow the response time of the lock-detect output.

Tone Detection

Figure 4 shows the generalized circuit connection for tone detection. The logic outputs, Q and $\overline{Q}$ at pins 5 and 6 are normally at "high" and "low" logic states, respectively. When a tone is present within the detection band of the PLL, the logic state at these outputs becomes reversed for the duration of the input tone. Each logic output can sink 5mA of load current.

Both logic outputs at pins 5 and 6 are open-collector type stages, and require external pull-up resistors R_{L1} and R_{L2} as shown in Figure 4.

With reference to Figure 1 and 4, the function of the external circuit components can be explained as follows : R0 and C0 set VCO center frequency, R1 sets the detection bandwidth, C1 sets the lowpass-loop filter time constant and the loop damping factor, and R_{L1} and R_{L2} are the respective pull-up resistors for the Q and $\overline{Q}$ logic outputs.



(Data Output is "low" when no carrier is present)

Figure 3. FSK Demodulation with Carrier Detect Capability

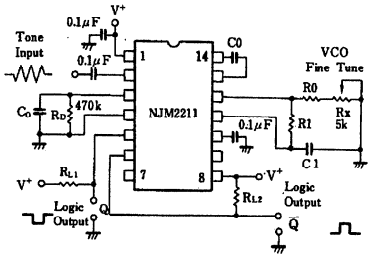


Figure 4. Tone Detection

Design Instructions

The circuit of Figure 4 can be optimized for any tone-detection application by the choice of five key circuit components : R0, R1, C0, C1, and C_D. For a given input tone frequency, f_S, these parameters are calculated as follows :

1. Chose R0 to be in the range of 15kΩ to 100kΩ. This choice is arbitrary.
2. Calculate C0 to set center frequency, f_0 equal to f_S : C0=1 / R0fs.
3. Calculate R1 to set bandwidth ±Δf (see Design Equation No.5) : R1=R0 (f_0 / Δf)

Note : The total detection bandwidth covers the frequency range of f_0=Δf

4. Calculate value of C1 for a given loop damping factor :
   $C1=C0 / 16\xi^2$
   Normally $\xi \approx 1/2$ is optimum for most tone-detector applications, giving C1=0.25 C0.
   Increasing C1 improves the out-of band signal rejection, but increases the PLL capture time.
5. Calculate value of filter capacitor C_D. To avoid chatter at the logic output, with R_D=470kΩ, C_D must be :
   C_D (μF) ≥ (16 / capture range in Hz)
   Increasing C_D slows the logic output response time.

Design Examples

Tone detector with a detection band of 1kHz±20Hz :

Step 1 : Choose R0=20kΩ (18kΩ in series with 5kΩ potentiometer).
Step 2 : Choose C0 for f_0=1kHz : C0 =0.05μF.
Step 3 : Calculate R1 : R1=(R0)(1000 / 20)=1MΩ.
Step 4 : Calculate C1 : for ξ=1 / 2, C1=0.25μF, C2=0.013μF.
Step 5 : Calculate C_D : C_D=16 / 38=0.42μF.
Step 6 : Fine tune the center frequency with the 5kΩ potentiometer, R_X.

Linear FM Detection

The **NJM2211** can be used as a linear FM detector for a wide range of analog communications and telemetry applications. The recommended circuit connection for the application is shown in Figure 5. The demodulated output is taken from the loop phase detector output (pin 11), through a post detection filter made up of R_F and C_F, and an external buffer amplifier. This buffer amplifier is necessary because of the high impedance output at pin 11. Normally, a non-inverting unity gain op amp can be used as a buffer amplifier, as shown in Figure 5.

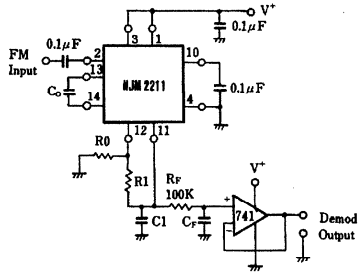


Figure 5. Linear FM Detector

The FM detector gain, i.e., the output voltage change per unit of FM deviation, can be given as :

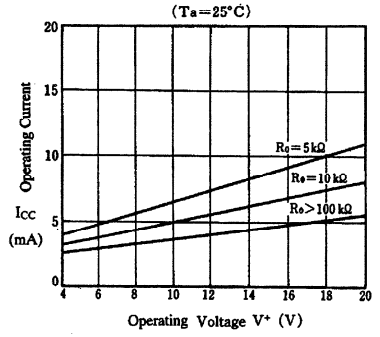
V_{OUT}=R1 V_R/100 R0 Volts/% deviation

where V_R is the internal reference voltage. For the choice of extremal components R1, R0, C_D, C1 and C_F, see the section on Design Equations.

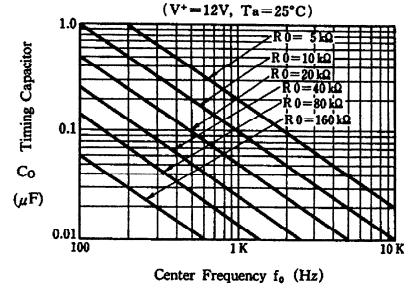
NJM2211

■ TYPICAL CHARACTERISTICS

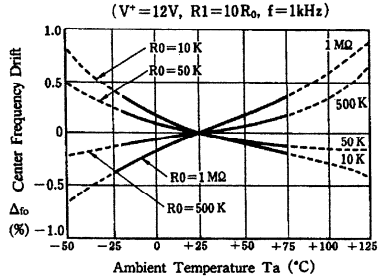
Operating Current
(Ta=25°C)



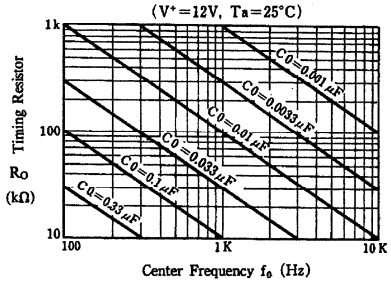
VCO Frequency
(V+=12V, Ta=25°C)



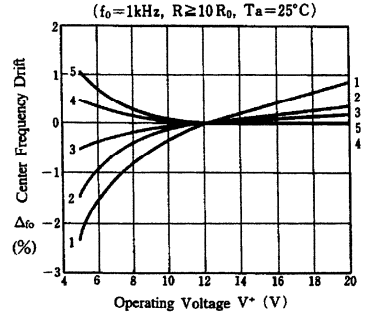
Center Frequency Drift
(V+=12V, R1=10R0, f=1kHz)



VCO Frequency
(V+=12V, Ta=25°C)



Center Frequency
(fo=1kHz, R≧10R0, Ta=25°C)



Curve	R0
1	5 K
2	10 K
3	30 K
4	100 K
5	300 K

[CAUTION]
The specifications on this databook are given for information , without any guarar as regards either mistakes or omissions. application circuits in this databook are described only to show representative us of the product and not intended for the guarantee or permission of any right incl. the industrial rights.

DOC10

QUARTZ CRYSTAL OSCILLATOR

■ GENERAL DESCRIPTION

The NJU6323 series is a C-MOS quartz crystal oscillator which consists of an oscillation amplifier, 3-stage divider, output frequency selector and 3-state output buffer.

The oscillation frequency is as wide as up to 50MHz and the symmetry of 45-55% is realized over full oscillation frequency range.

The oscillation amplifier incorporates feed-back resistance and oscillation capacitors(Cg, Cd), therefore, it requires no external component except quartz crystal.

The 3-stage divider outputs f_o, $f_o/2$, $f_o/4$ and $f_o/8$ to the output frequency selector and it determined one output frequency according to the combination of two input-signal.

The 3-state output buffer is C-MOS compatible and capable of 10 LSTTL driving.

■ FEATURES

- Operating Voltage -- 3.0~6.0V
- Maximum Oscillation Frequency -- 50MHz
- Low Operating Current
- High Fan-out -- LSTTL 10
- 3-state Output Buffer
- Selected Frequency Output (mask option)
  Only one frequency out of f0, $f_o/2$, $f_o/4$ and $f_o/8$ output
- Oscillation Capacitors Cg and Cd on-chip
- Oscillation and/or Output Stand-by Function
- Package Outline -- CHIP/EMP 8
- C-MOS Technology

■ LINE-UP TABLE

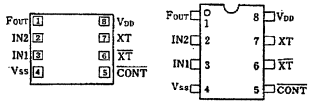
Type No.	Cg	Cd	Osc.Stop Function
NJU6323	21pF	23pF	Yes
NJU6323J	21pF	No	Yes
NJU6323P	No	No	Yes

■ PACKAGE OUTLINE

NJU6323XC NJU6323XE

4

■ PIN CONFIGURATION/PAD LOCATION



■ COORDINATES

Unit: μm

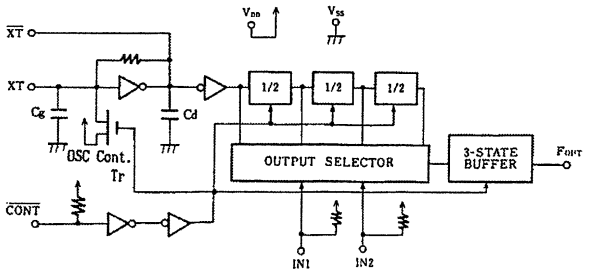
No.	PAD	X	Y
1	F_{OUT}	165	651
2	IN2	165	484
3	IN1	165	317
4	V_{SS}	165	149
5	$\overline{CONT}$	1113	149
6	$\overline{XT}$	1113	317
7	XT	1113	484
8	V_{DD}	1113	651

Chip Size : 1.28 X 0.8mm
Chip Thickness : 400μm±30μm

DOC11

4

■ BLOCK DIAGRAM



■ TERMINAL DESCRIPTION

NO.	SYMBOL	FUNCTION
5	$\overline{CONT}$	Oscillation Stop Control and Divider Reset $\overline{CONT}$ = H: F_{OUT} = Output either one frequency from f_o, $f_o/2$, $f_o/4$, and $f_o/8$ $\overline{CONT}$ = L: Oscillation Stop, Output High Impedance and Divider Reset
6	$\overline{XT}$	Quartz Crystal Connecting Terminals
7	XT	
8	V_{DD}	+ 5V
3	IN1	3-Stage Divider Outputs Selected by IN1 and IN2
2	IN2	IN1 / IN2 / F_{OUT}: H / H / f_o; L / H / $f_o/2$; H / L / $f_o/4$; L / L / $f_o/8$
1	F_{OUT}	Output either one frequency from f_o, $f_o/2$, $f_o/4$, and $f_o/8$
4	V_{SS}	GND

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	-0.5 ~ +7.0	V
Input Voltage	V_{IN}	-0.5 ~ V_{DD}+0.5	V
Output Voltage	V_O	-0.5 ~ V_{DD}+0.5	V
Input Current	I_{IN}	±10	mA
Output Current	I_O	±25	mA
Power Dissipation (EMP)	P_D	200	mW
Operating Temperature Range	Topr	-40 ~ + 85	℃
Storage Temperature Range	Tstg	-65 ~ +150	℃

(Note) Decoupling capacitor should be connected between V_{DD} and V_{SS} due to the stabilized operation for the circuit.

TOSHIBA FIELD EFFECT TRANSISTOR SILICON N CHANNEL JUNCTION TYPE

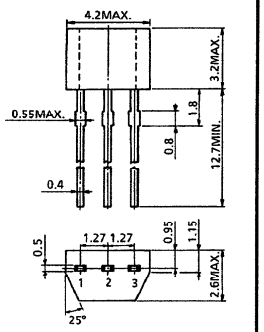
2SK192A

FM TUNER APPLICATIONS

VHF BAND AMPLIFIER APPLICATIONS

- High Power Gain : G_{PS}=24dB (Typ.) (f=100MHz)
- Low Noise Figure : NF=1.8dB (Typ.) (f=100MHz)
- High Forward Transfer Admittance : $|y_{fs}|$=7mS (Typ.) (f=1kHz)

Unit in mm



1. DRAIN
2. SOURCE
3. GATE

JEDEC	—
EIAJ	—
TOSHIBA	2-4E1D

Weight : 0.13g

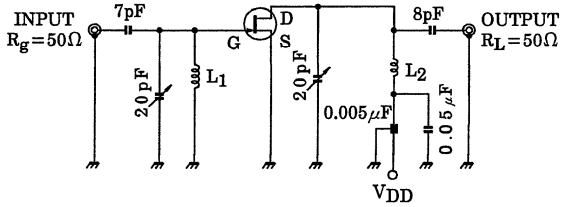
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Gate-Drain Voltage	V_{GDO}	−18	V
Gate Current	I_G	10	mA
Drain Power Dissipation	P_D	200	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current	I_{GSS}	V_{GS}=−1.0V, V_{DS}=0	—	—	−10	nA
Gate-Drain Breakdown Voltage	$V_{(BR)GDO}$	I_G=−100μA	−18	—	—	V
Drain Current	I_{DSS} (Note)	V_{GS}=0, V_{DS}=10V	3	—	24	mA
Gate-Source Cut-off Voltage	$V_{GS(OFF)}$	V_{DS}=10V, I_D=1μA	−1.2	−3	—	V
Forward Transfer Admittance	$\|y_{fs}\|$	V_{GS}=0, V_{DS}=10V, f=1kHz	—	7	—	mS
Input Capacitance	C_{iss}	V_{DS}=10V, V_{GS}=0, f=1MHz	—	3.5	—	pF
Reverse Transfer Capacitance	C_{rss}	V_{DS}=−10V, f=1MHz	—	–	0.65	pF
Power Gain	G_{PS}	V_{DD}=10V, f=100MHz (Fig.1)	—	24	—	dB
Noise Figure	NF	V_{DD}=10V, f=100MHz (Fig.1)	—	1.8	3.5	dB

Note : I_{DSS} Classification Y : 3.0~7.0, GR : 6.0~14.0, BL : 12.0~24.0

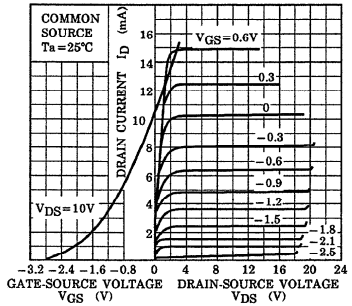


L_1 : 0.8mmϕ Ag PLATED Cu WIRE 3 TURNS, 10mm I_D, 10mm LENGTH

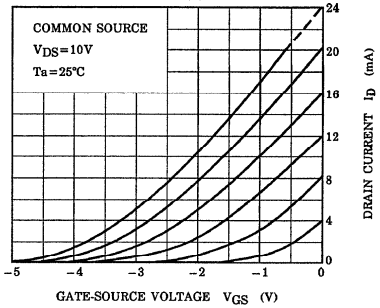
L_2 : 0.8mmϕ Ag PLATED Cu WIRE 3.5 TURNS, 10mm I_D, 10mm LENGTH

Fig.1 100MHz G_{ps}, NF TEST CIRCUIT

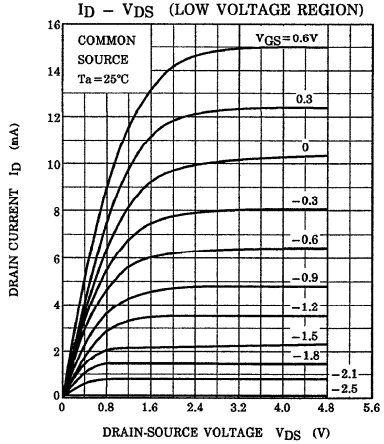
STATIC CHARACTERISTICS



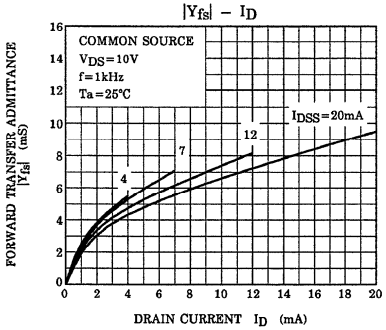
I_D – V_{GS}



I_D – V_{DS} (LOW VOLTAGE REGION)

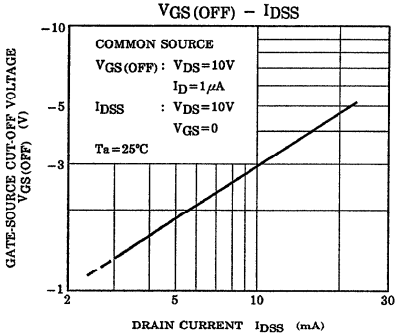


$|Y_{fs}|$ – I_D

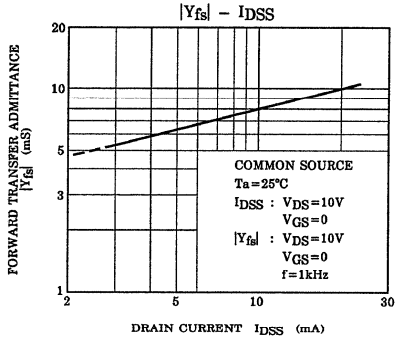


DOC12

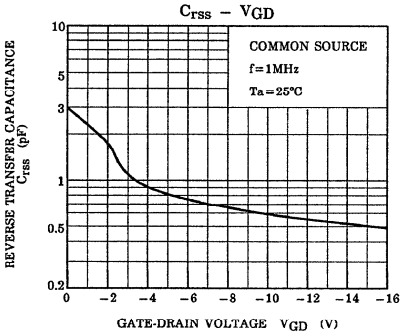
$V_{GS(OFF)}$ – I_{DSS}



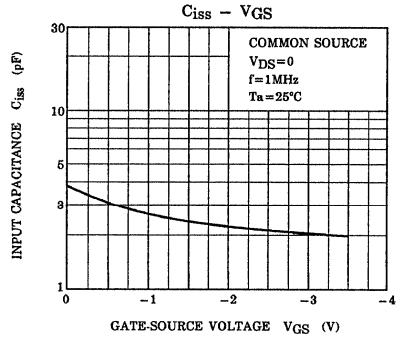
$|Y_{fs}|$ – I_{DSS}



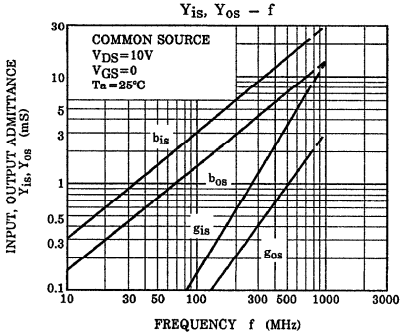
C_{rss} – V_{GD}



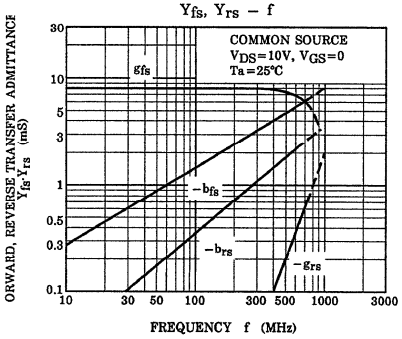
C_{iss} – V_{GS}



Y_{is}, Y_{os} – f

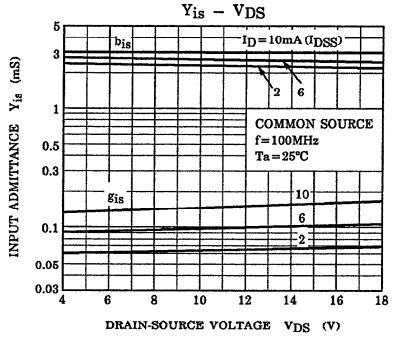


Y_{fs}, Y_{rs} – f

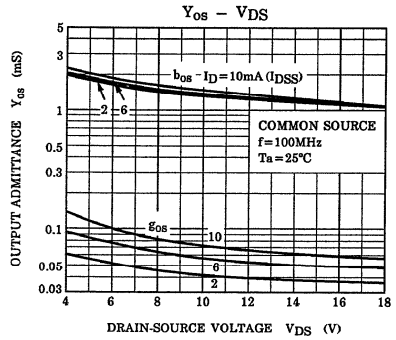


TOSHIBA 2SK192A

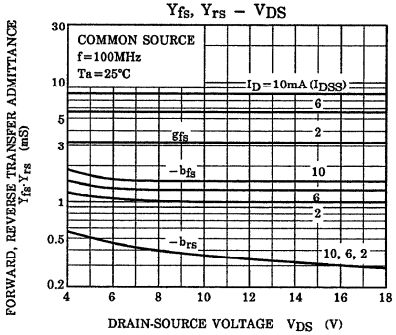
Y_{is} – V_{DS}



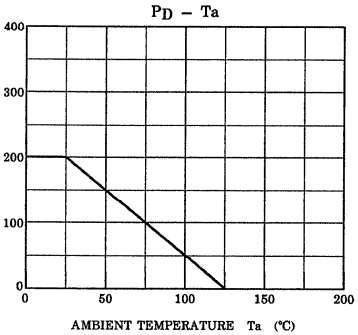
Y_{os} – V_{DS}



Y_{fs}, Y_{rs} – V_{DS}



P_D – Ta



DOC13

Ordering number:EN3006

N-Channel Junction Silicon FET

2SK937

High-Frequency General-Purpose Amplifier Applications

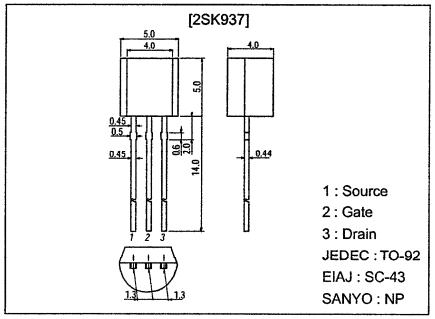
Features

- Adoption of FBET process.
- Large $|y_{fs}|$.
- Small Ciss.

Package Dimensions

unit:mm

2019B



Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Drain-to-Source Voltage	V_{DSX}		40	V
Gate-to-Drain Voltage	V_{GDS}		–40	V
Gate Current	I_G		10	mA
Drain Current	I_D		100	mA
Allowable Power Dissipation	P_D		300	mW
Junction Temperature	Tj		150	°C
Storage Temperature	Tstg		–55 to +150	°C

Electrical Characteristics at Ta = 25°C

Parameter	Symbol	Conditions	Ratings min	Ratings typ	Ratings max	Unit
Gate-to-Drain Breakdown Voltage	$V_{(BR)GDS}$	I_G=–10μA, V_{DS}=0	–40			V
Gate-to-Source Leakage Current	I_{GSS}	V_{GS}=–20V, V_{DS}=0			–1.0	nA
Zero-Gate Voltage Drain Current	I_{DSS}	V_{DS}=10V, V_{GS}=0	40*		75*	mA
Cutoff Voltage	$V_{GS(off)}$	V_{DS}=10V, I_D=100μA	–2.0	–3.0	–5.0	V
Forward Transfer Admittance	$\|yfs\|_1$	V_{DS}=10V, I_D=10mA, f=1kHz	10	15		mS
	$\|yfs\|_2$	V_{DS}=10V, V_{GS}=0, f=1kHz	22	30		mS

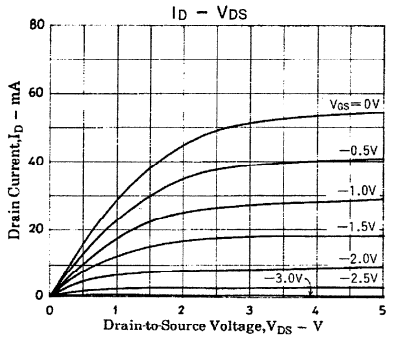
* : The 2SK937 is classified by I_{DSS} as follows (unit : mA) :

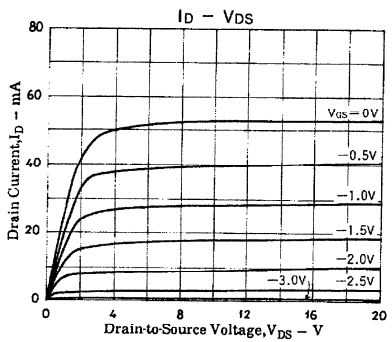
40	Y3	52	48	Y4	63	57	Y5	75

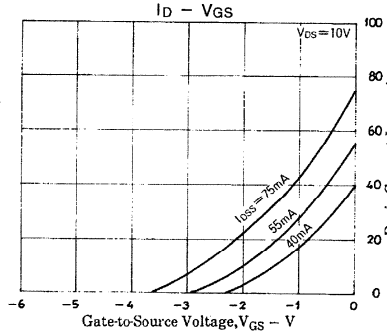
Continued on next page.

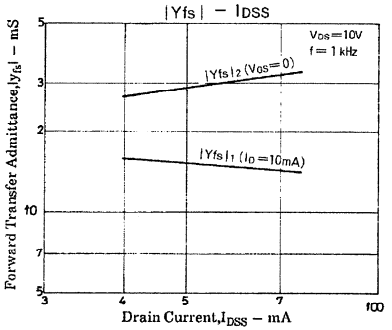
Continued from preceding page.

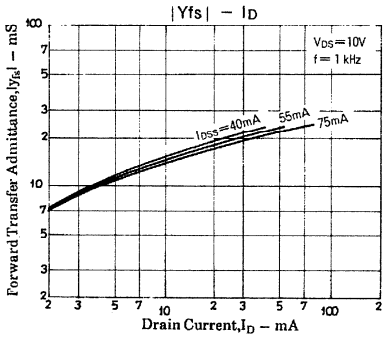
Parameter	Symbol	Conditions	Ratings	Unit
Input Capacitance	Ciss	V_{DS}=10V, V_{GS}=0, f=1MHz	11	pF
Reverse Transfer Capacitance	Crss	V_{DS}=10V, V_{GS}=0, f=1MHz	2.5	pF
Noise Figure	NF	V_{DS}=10V, Rg=1kΩ, I_D=1mA, f=1kHz	1.5	dB

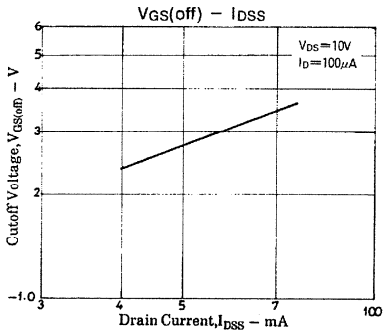












DOC14

DC / DC converter

BP5220 / BP5221 / BP5222 / BP5220X / BP5221X / BP5222X

The BP5220, BP5221, BP5222, BP5220X, BP5221X, and BP5222X are DC / DC converters that use a pulse width modulation (PWM) system. They contain control circuits, switching devices, rectifiers, and coils, and operate by only connecting an I / O smoothing capacitor. With a high efficiency of power conversion, the modules are available in stand-alone 9-pin SIP packages with no heat sink required. They can be applied to various purposes by fine-adjusting the output voltage and switching on and off. With a wide range of input voltage, the modules are best suited for obtaining a stable local power supply from a main power supply with a large voltage variation.

● Applications

Power supplies for copiers, personal computers, facsimiles, AV equipment, measuring instruments, vending machines, security device, registers, industrial equipment, and maintenance tools

● Features

1) Wide range of input voltage.
2) High power conversion efficiency.
3) Built-in output ON / OFF switch.
4) Applicable to various purposes by fine-adjusting the output voltage.
5) Small number of external components required.
6) Heat sink unnecessary.
7) Compact package.
   BP5220 / BP5221 / BP5222 : SIP9
   BP5220X / BP5221X / BP5222X : SIP9(L-shaped lead type)

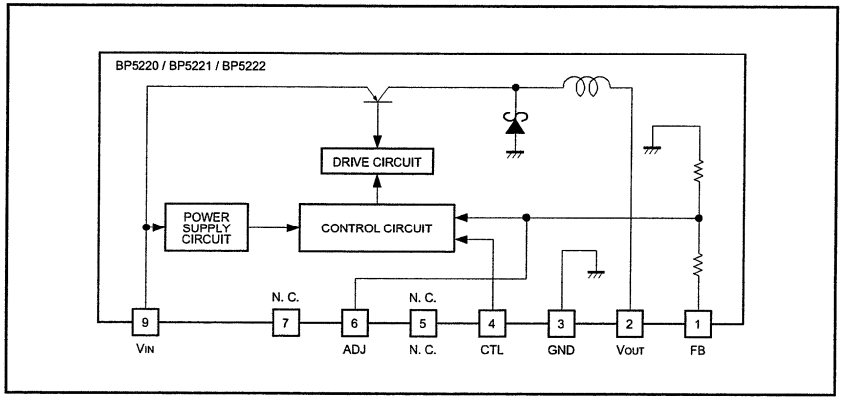
● List of the series

	BP5220 / BP5220X	BP5221 / BP5221X	BP5222 / BP5222X	Unit
Input voltage	8~38	8~38	15~38	V
Output voltage	5	5	12	V
Output current	1	0.5	0.5	A
Power conversion effciency	85 (V_{IN}=15V)	84 (V_{IN}=15V)	90 (V_{IN}=20V)	%

● Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits			Unit
		BP5220 / BP5220X	BP5221 / BP5221X	BP5222 / BP5222X	
Input voltage	V_{IN}	8~38	8~38	15~38	V
Output current	Io	1	0.5	0.5	A
Operating temperature range	Topr	–20~+70			°C
Storage temperature range	Tstg	–25~+80			°C

● Block diagram



● Electrical characteristics BP5220 / BP5220X (Unless otherwise noted: V_{IN}=15V, Io=0.5A, SW=1, Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input voltage	V_{IN}	8	–	38	V	
Output voltage	Vo	4.75	5	5.25	V	
Output current	Io	–	–	1	A	V_{IN} < 30V *1
Line regulation	ΔV_{O1}	–	35	80	mV	V_{IN}=8V~38V
Load regulation	ΔV_{O2}	–	20	80	mV	Io=0.1A~1A
Output ripple voltage	V_r	–	30	70	mV_{PP}	*2
Power conversion efficiency	η	75	85	–	%	Io=1A
Switching frequency	fsw	–	190	–	kHz	
CTL pin ON resistance	Ron	–	–	4.7	kΩ	Vo > 4.75V
CTL pin OFF resistance	Roff	200	–	–	kΩ	Vo < 0.1V, SW=2 select

*1 Derating required according to the input voltage and ambient temperature.
*2 Pulse noise not included.

BP5221 / BP5221X (Unless otherwise noted: V_{IN}=15V, Io=0.25A, SW=1, Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input voltage	V_{IN}	8	–	38	V	
Output voltage	Vo	4.75	5	5.25	V	
Output current	Io	–	–	0.5	A	*1
Line regulation	ΔV_{O1}	–	35	80	mV	V_{IN}=8V~38V
Load regulation	ΔV_{O2}	–	20	80	mV	Io=0.05A~0.5A
Output ripple voltage	V_r	–	30	70	mV_{PP}	*2
Power conversion efficiency	η	70	84	–	%	Io=0.5A
Switching frequency	fsw	–	190	–	kHz	
CTL pin ON resistance	Ron	–	–	4.7	kΩ	Vo > 4.75V
CTL pin OFF resistance	Roff	200	–	–	kΩ	Vo < 0.1V, SW=2 select

*1 Derating required according to the input voltage and ambient temperature.
*2 Pulse noise not included.

DOC15

RICOH

LOW DROPOUT VOLTAGE REGULATOR

RN5RT SERIES

NO. EA-038-0204

OUTLINE

The RN5RT Series are CMOS-based voltage regulator ICs with high output voltage accuracy and low supply current developed . Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, output voltage setting resistors and a current limit circuit.

The output voltage of these ICs is fixed with high accuracy.

The built-in Driver Transistor of low ON Resistance permits developing of low dropout CMOS type regulator as RN5RT Series.

Even if VOUT is shorted to GND, the current limit circuit protects the ICs from destruction.

Furthermore, these ICs have a chip enable function, so that the supply current on standby can be minimized.

Since the package for these ICs is the SOT-23-5 (Mini-mold) package, high density mounting of the ICs on boards is possible.

FEATURES

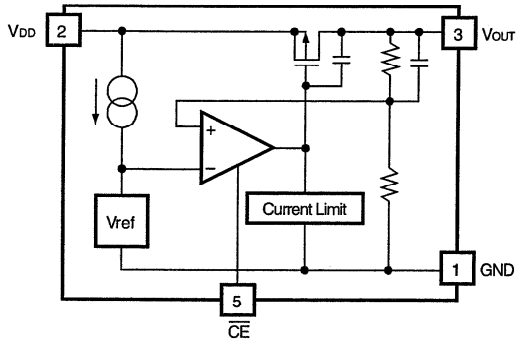
- Ultra-Low Supply Current ..... Typ. 4μA (except ICEL)
- Standby Mode ..... Typ. 0.1μA
- Low Dropout Voltage ..... Typ. 0.3V (IOUT=60mA, RN5RT30A)
- Low Temperature-Drift Coefficient of Output Voltage ..... Typ. ±100ppm/°C
- Excellent Line Regulation ..... Typ. 0.15%/V
- Output Voltage ..... Stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V is possible (refer to Selection Guide).
- High Accuracy Output Voltage ..... ±2.0%
- Built-in Current Limit Circuit ..... Typ. 30mA
- Small Package ..... SOT-23-5 (Mini-mold)

APPLICATIONS

- Power source for battery-powered equipment.
- Power source for cellular phones, cameras, VCRs, camcorders, hand-held audio instruments and hand-held communication equipment.
- Power source for domestic appliances.

DOC16

BLOCK DIAGRAM



SELECTION GUIDE

The output voltage, the packing type, and the taping type for the ICs can be selected at the user's request. These selections can be made by designating the part number as shown below:

RN5RTxxxx-x ← Part Number
↑↑↑ ↑
a bc d

Code	Contents
a	Setting Output Voltage (VOUT) : Stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V is possible.
b	A
c	Designation of Packing Type : A : Taping C : Antistatic bag (for Samples only)
d	Designation of Taping Type : Ex. TR, TL (refer to Taping Specifications ; TR type is the standard direction.)

F) HORAIRES DE DIFFUSION DES ZONES I,II & III

Donné en heure UMT, en France rajouter 1 heure en horaire d'hiver et 2 heures en l'horaire d'été.

HORAIRES DE TRANSMISSIONS NAVTEX (correct to March 2003):

Horaires (UTC/GMT)						CAT	Khz	Station	Pays	Lat	Long	Commentaires
00.00	04.00	08.00	12.00	16.00	20.00	A	518	Svalbard	Norvège	78.04N	13.38E	
						A	518	Corsen	France	48.28N	05.03W	
00.10	04.10	08.10	12.10	16.10	20.10	B	518	Bodo	Norvège	67.16N	14.23E	
		08.20			20.20	C	490	Portpatrick	GB	54.51N	05.07W	
00.20	04.20	08.20	12.20	16.20	20.20	P	518	Haifa	Israël	32.49N	35.00E	
00.30	04.30	08.30	12.30	16.30	20.30	D	518	Grimeton	Suède	57.07N	12.24E	
						D	518	Corunna	Espagne	43.31N	08.27W	
						D	518	Istanbul	Turquie	41.04N	28.57E	
00.40	04.40	08.40	12.40	16.40	20.40	E	518	Niton	GB	50.35N	01.18W	
						E	518	Samsun	Turquie	41.17N	38.20E	
						E	490	Corsen	France	48.28N	05.03W	Français
00.50	04.50	08.50	12.50	16.50	20.50	F	518	Arkhangelsk	Russie	64.33N	40.32E	
						F	518	Horta	Açores	38.32N	28.38W	
						F	518	Antalya	Turquie	36.53N	30.42E	
01.00	05.00	09.00	13.00	17.00	21.00	B	518	Kersh	Ukraine	45.23N	36.28E	
						G	518	Cullercoats	GB	55.02N	01.26W	
						G	518	Tarifa	Espagne	36.01N	05.34W	
						G	490	Monsanto	Portugal	38.44N	09.11W	Portuguais
01.10	05.10	09.10	13.10	17.10	21.10	H	518	Bjuroklubb	Suède	64.28N	21.36E	
						H	518	Iraklion	Crète	35.20N	25.07E	
01.20	05.20	09.20	13.20	17.20	21.20	C	518	Murmansk	Russie	68.58N	33.05E	
						I	518	Izmir	Turquie	38.21N	26.35E	
						I	518	Las Palmas	Canaries	28.09N	15.25W	
						J	490	Horta	Açores	38.32N	28.38W	Portuguais
	05.20			17.20		I	490	Niton	GB	50.35N	01.18W	
01.30	05.30	09.30	13.30	17.30	21.30	J	518	Gislovhammar	Suède	55.29N	14.19E	
						J	518	Varna	Bulgarie	43.07N	27.46E	
01.40	05.40	09.40	13.40	17.40	21.40	K	518	Niton	GB	50.35N	01.18W	
						K	518	Kerkyra	Grèce	39.37N	19.55E	
01.50	05.50	09.50	13.50	17.50	21.50	L	518	Rogaland	Norvège	58.48N	05.34E	
						L	518	Limnos	Grèce	39.52N	25.04E	
02.00	06.00	10.00	14.00	18.00	22.00	M	518	Oostende	Belgique	51.11N	02.48E	
						M	518	Cyprus	Chypre	35.03N	33.17E	
						M	518	Casablanca	Maroc	33.36N	07.38W	
						M	490	Porto Santo	Madère	33.04N	16.20W	Prévu
02.10	06.10	10.10	14.10	18.10	22.10	N	518	Orlandet	Norvège	63.41N	09.31.E	
						N	518	Alexandria	Egypte	31.12N	29.52E	
02.20	06.20	10.20	14.20	18.20	22.20	O	518	Portpatrick	GB	54.51N	05.07W	
						O	518	Malta	Malte	35.49N	14.32E	
02.30	06.30	10.30	14.30	18.30	22.30	C	518	Odessa	Ukraine	46.29N	30.44E	
						P	518	Den Helder	Hollande	52.06N	04.15E	
						P	518	Porto Santo	Madère	33.04N	16.20W	
02.40	06.40	10.40	14.40	18.40	22.40	Q	518	Malin Head	Irlande	55.22N	07.21W	
						Q	518	Split	Croatie	43.30N	16.29E	
02.50	06.50	10.50	14.50	18.50	22.50	R	518	Reykjavik	Islande	64.05N	21.51W	
						R	518	Rome	Italie	41.37N	12.29E	
						R	518	Monsanto	Portugal	38.44N	09.11W	
03.00	07.00	11.00	15.00	19.00	23.00	A	518	Novorossiysk	Russie	44.27N	37.44E	
						S	490	La Garde	France	43.06N	05.59E	Français
03.10	07.10	11.10	15.10	19.10	23.10	T	518	Oostende	Belgique	51.11N	02.48E	
						T	518	Cagliari	Italie	39.13N	09.14E	
						T	490	Niton	GB	50.35N	01.18W	Français
03.20	07.20	11.20	15.20	19.20	23.20	U	518	Tallin	Estonie	59.30N	24.30E	
						U	518	Trieste	Italie	45.40N	13.46E	
	07.20			19.20		U	490	Cullercoats	UK	55.02N	01.26W	
03.30	07.30	11.30	15.30	19.30	23.30	V	518	Vardo	Norvège	70.22N	31.06E	
						V	518	Augusta	Italie	37.14N	15.14E	
03.40	07.40	11.40	15.40	19.40	23.40	W	518	La Garde	France	43.06N	05.59E	
						W	518	Valentia	Irlande	51.56N	10.21W	
03.50	07.50	11.50	15.50	19.50	23.50	X	518	Reykjarvik	Islande	64.05N	21.51W	
						X	518	Valencia	Espagne	38.43N	00.09E	
						X	518	Serapeum	Egypte	30.28N	32.22E	