PS/RF/NOTE 86-4
JS/gm - 27.1.1986

RATIONAL FREQUENCY MULTIPLIER

R. Garoby
J. Schipper

1. Function

This NIM-module is an RF-synthesizer for the ferrite cavities of the PS, developped for the ACOL $\bar{p}$ production beam.

2. Specifications

- 4 TTL/50 Ω outputs with a frequency equal to F_{out} = f-clock $\frac{F}{2^{23}}$

  F = digital frequency word (TTL levels)
- Fast frequency change ($\lesssim$ 1 μs) without phase discontinuity.
- Possibility to synchronize the output with "F-rev" (reference pulse train), after a "start synchro" pulse has been given.
- Clock frequency 2 to 30 MHz

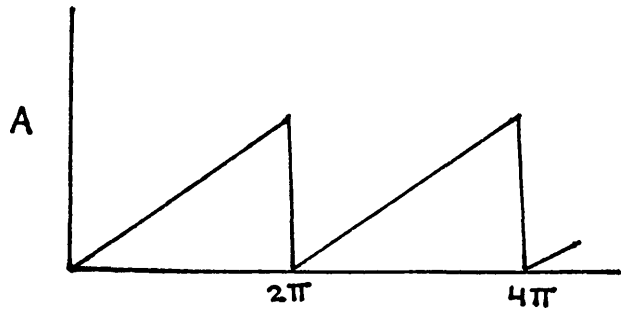
  Output frequency 0.1 to 5 MHz.

3. Description

The input word F consists of 25 bits (25-gnd, 23-N.C.), bits 1-22 form the data (TTL levels - 470 Ω pull-up resistors). Bit 24 is used to latch the data, this latching is synchronized with the internal clock system.

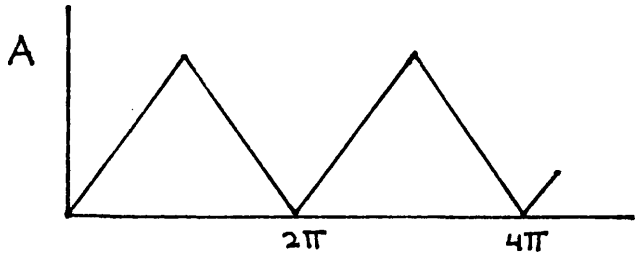
These TTL levels are translated in ECL. The resulting digital word is then used as the input of a digital integrator, clocked by the external "clock" signal.

For a constant input word, the result is a linearly increasing digital word at the output of the 24 bits adder. Since the adder output regularly overflows, seen in an analog form, it looks almost like a sawtooth. In order to decrease the amplitudes of the harmonics the sawtooth is then transformed into a triangle.



Fourier function sawtooth

$$f(t) = \frac{A}{2} - \frac{A}{\pi} (\sin\omega t + \frac{1}{2} \sin 2\omega t + \frac{1}{3} \sin 3\omega t + \ldots)$$



Fourier function triangle

$$f(t) = \frac{A}{2} - \frac{4A}{\pi^2} (\cos\omega t + \frac{1}{3^2} \cos 3\omega t + \frac{1}{5^2} \cos 5\omega t + \ldots)$$

After being latched, the digital word will be converted into an analog signal, followed by a low pass filter (5 MHz), shaping and distribution system (TTL level/50Ω).

There is also the possibility to synchronize the output with an external frequency (F-rev. input) after a "start synchro" pulse has been given (IC7, IC10, IC26).

That is obtained by resetting the adder output latches in synchronism with the external reference.

8 bit RFM - PS/RF-LL2012/2-2 (Reference number)

10 bit RFM - PS/RF-LL2018/2-2 (Reference number).

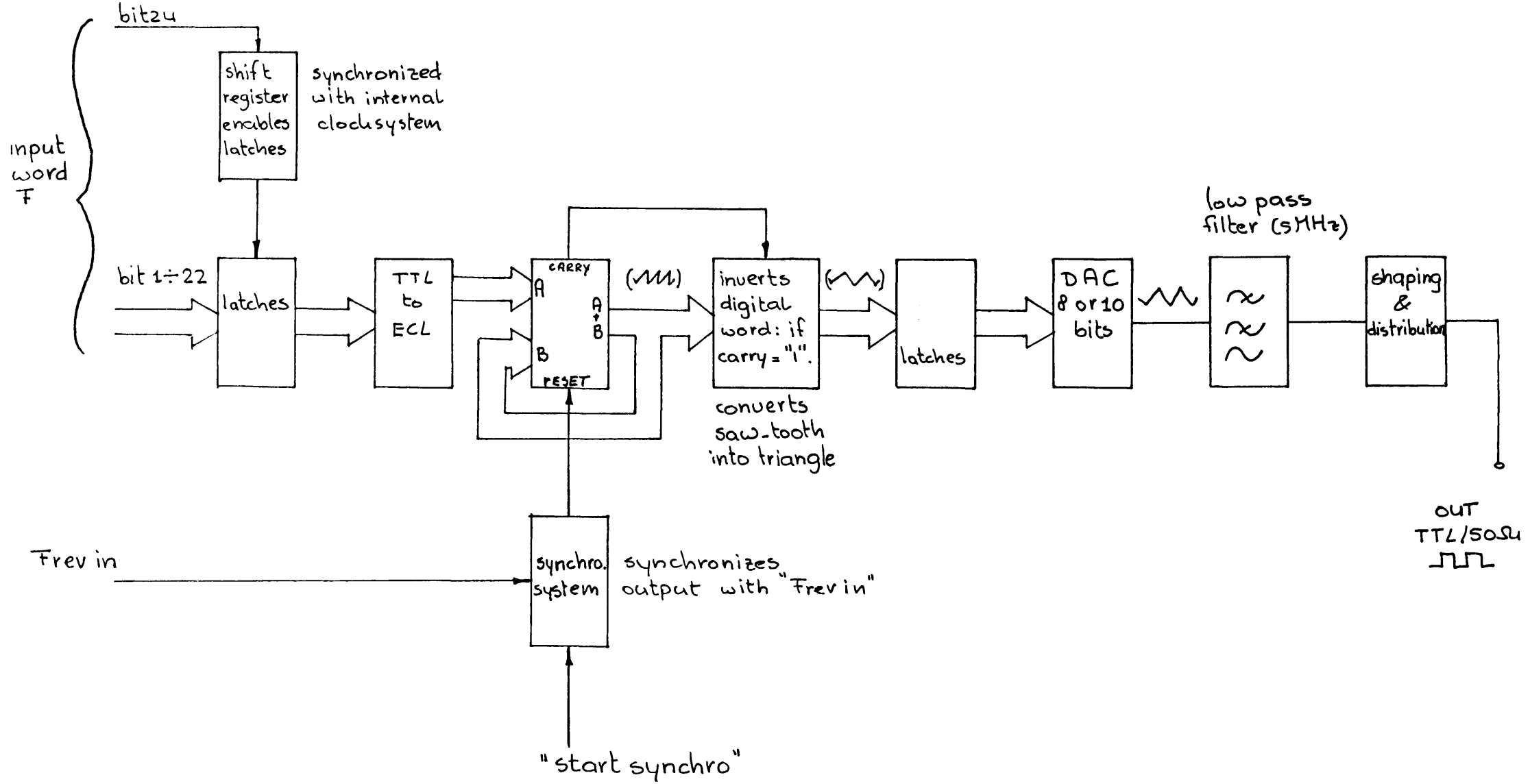
References

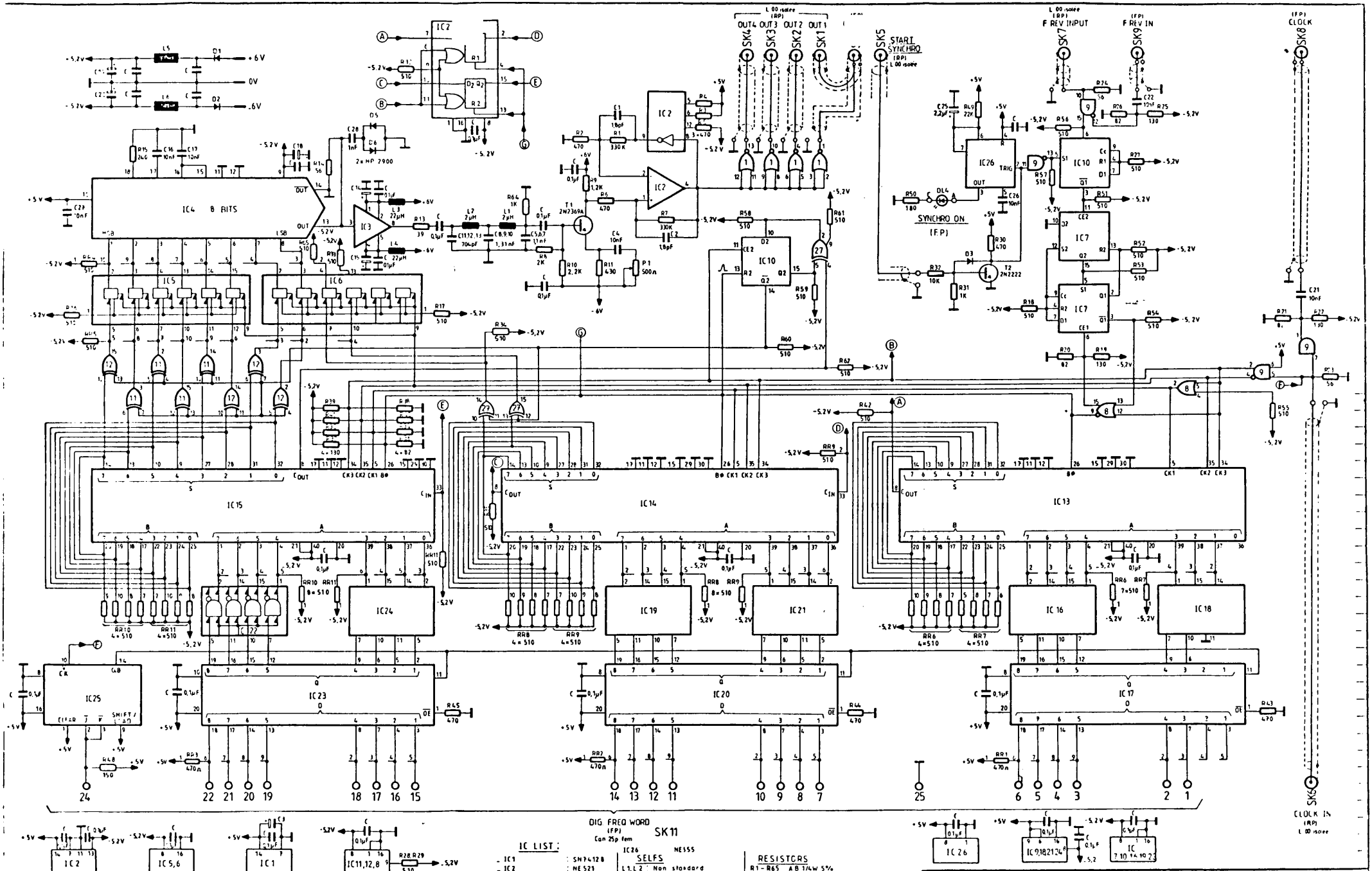
1. SPS/ARF, Note on SPS 6022 Frequency synthesizer, 1975, handwritten note.

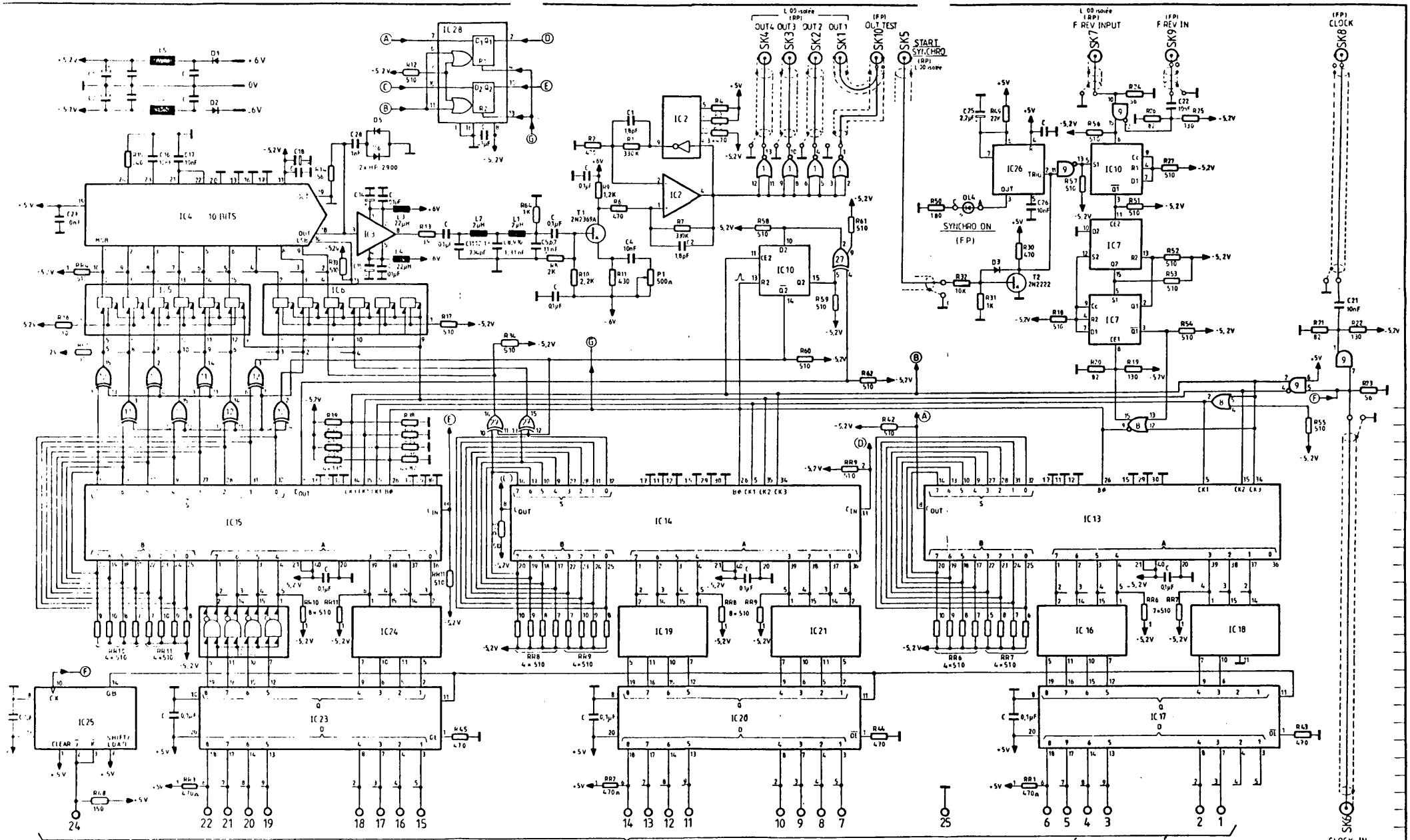
2. "Direct Digital Frequency Synthesis", Rodger H. Horking (Rockland) and H.W. Cooper, Electronic Design 15, July 19, p. 17, 1974.

3. "Frequency Synthesis: Techniques and Applications", Jersky, Gorski and Popiel, IEEE Press, p. 25, 1975.

RFM-block diagram.




IC4 8 BITS
IC5
IC6
IC15
IC14
IC13
IC24
IC19
IC21
IC16
IC18
IC25
IC23
IC20
IC17
IC2
IC3
IC1
IC10
IC7
IC76
SK4 OUT4 OUT3 OUT2 OUT1
SK5 START SYNCHRO
SK7 F REV INPUT
SK9 F REV IN
SK8 CLOCK
SK6 CLOCK IN
SYNCHRO ON (FP)
DIG FREQ WORD (FP) Con 25p fem SK11
IC LIST :
SELFS
CAPACITORS
RESISTORS
RATIONAL FREQUENCY MULTIPLIER 8 BITS
CABLING DIAGRAM
DESSINE
CONTROLE
REMPLACE
REMPLACE PAR
REDUCTION
ECHELLE SCALE
PS/RF-LL 2012/2_2
INDICE B



IC LIST :

IC1	SN74128
IC2	NE 521
IC3	LM 002 LN
IC4	SP 9798 08
IC5, IC6	MC 10186
IC7, IC10, IC28	MC 10 231
IC8	MC 10103
IC9, IC16, IC18, IC19, IC21, IC22, IC24	MC 10124
IC11, IC12, IC27	MC 10113
IC13, IC14, IC15	SP 92 18
IC17, IC20, IC23	74LS 374
IC25	74LS 195
IC26	NE555

SELFS

L1, L2 : Non standard
L3, L4 : Philips 07 91 19 2560
L5, L6 : Ferroxcube

CAPACITORS

C, C16, C19, C29 : Ceramic
C1, C2, C4 – C13 / C21 – C24, C26, C28 : Mica
C3, C14, C15 / C18 – C20, C25 : Tantale perle
C23, C24 : Do not exist

RESISTORS

R1 – R64 : AB 1/4W 5%
R46, R49, R63 : Do not exist
RR1 ÷ RR11 : NETWORKS

SK1 – SK7 : LEMO 00 09.46.11.110.0
SK8 – SK10 : LEMO 00 09.46.11.180.6
SK11 : Cannon 25p f 09.21.22.090.2

DATE	NOM	ZONE	MODIFICATION

(J 349)

RATIONAL FREQUENCY MULTIPLIER 10 BITS

CABLING DIAGRAM

ECHELLE SCALE	DESSINÉ	Lambert JP 11/04/84
	CONTRÔLÉ	
	REMPLACE	PS/RF 7324 - FL2
	REMPLACÉ PAR	
	RÉDUCTION	

ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
CERN - DIV :.....
TEL (0022) 83 61 11
TELEX GENÈVE 2 30 98

PS/RF-LL 2018/2_2

INDICE B