1.3 GHZ PRESCALER

Design by P. Esser

Not only do the majority of frequency counters found in smaller workshops and laboratories not operate above 10 MHz, but usually they cannot be modified to work at higher frequencies either. To overcome that problem, here is a prescaler that delivers a clean rectangular signal at TTL level at frequencies up to 1.3 GHz and which can be used with virtually any frequency counter.

THE prescaler proposed here offers several advantages Firstly, it increases the measurement range of the frequency counter to which it is linked and, secondly, it makes it possible to use a much shorter cable between counter and instrument on test—see Fig 1 A disadvantage is, of course, that, to see the second metering range, you must look at both the counter and the prescaler

Scaler ICs

A first scaling down of the input signal is effected by a chip specially designed for this purpose This can be either the Telefunken Type U664B or the Siemens Type SDA4211 Block diagrams of these circuits are shown in Fig 2

The U664B was originally developed for use in the frequency synthesizer of a television receiver Without any additional components, it divides by 64 In the absence of an input signal, it operates in the highest frequency range Normally, the only external components required are two small capacitors

The SDA4211 offers two scaling factors: 64 or 256, depending on the potential at pin 5 If that pin is at +5 V, the input signal is divided by 64; when the pin is at earth, scaling is by 256 On the PCB,—see Fig 4— this selection is facilitated by a 3-way terminal strip and a jump link

The two circuits are fully interchangeable as regards pinout and function, but not, of course, in scaling factor

Two paths

The measured signal (frequency f_s) is split into two immediately after the input socket—see Fig 3 One part is fed to the prescaler proper (lower part of the diagram) via C_4, while the other is taken to a processing and amplifying section (upper part of the diagram) via L_1

Anti-parallel connected diodes D_2 and D_3 limit the level of the input signal to not more than ±700 mV. The signal is then applied to pin 2 of IC_3. The symmetrical input of this circuit is connected asymmetrically, since the second input, pin 3, is connected to ground via C_{11}. Jumper JP_1 is the earlier mentioned scaling selector if the SDA4211 is used. If the U664B is used, the 3-way terminal strip and jump link are not required

The measured signal (frequency f_s:64) is available at pin 6, from where it is applied to potential divider R_7-R_8-P_1 From there it is fed to amplifier T_3, whose output is applied to the first of three cascaded Type 74LS90 decade counters, IC_4, IC_5, and IC_2

Each of these counters divides its input signal by 2.5 This somewhat unusual scaling factor comes about as follows The upper half of the IC divides by 5. For every five input pulses, the Q_8 output goes high twice; in other words, the Q_8 output delivers an output pulse for every 2.5 input pulses The output of the cascaded threesome is thus a signal of frequency f_s:1000

The other part of the input signal is applied via L_1 and C_2 to T_1, which, connected as an common-emitter circuit, behaves exactly like an inverting opamp The voltage amplification of the stage is roughly the same as the open-loop amplification of the transistor, but it is dependent on the source impedance Diode D_1 limits the negative half of the signal to not more than –700 mV.

The output of the stage is taken from the collector of T_1 and then further amplified in T_2, which is also connected as a common-emitter circuit It is then taken from the collector of T_2 and applied to NAND Schmitt trigger IC_{1b}, which, with the other three NAND gates, ensures clean edges and correct gating of the two signals When switch S_1 is open, the original signal (f_s) is available at the output; when it is closed, the scaled down signal (f_s:1000) is at the output socket.

Construction

Populating the printed-circuit board shown in Fig 4 is straightforward, but greater care than usual is required around the input socket where surface-mount components are used Inductor L_1 must be wound by the constructor It consists of 2–3 turns enamelled copper wire (dia 0.4 mm) on a small ferrite core.

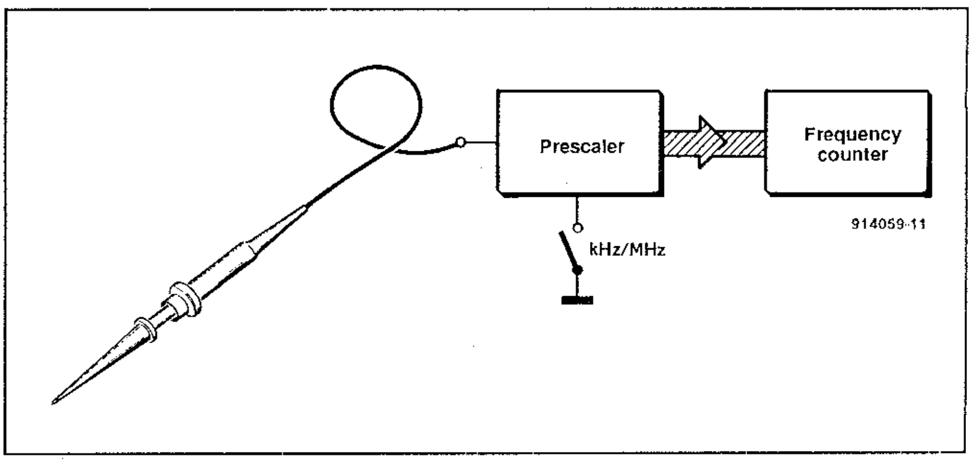

Fig. 1. Measuring set-up of counter, prescaler and probe.

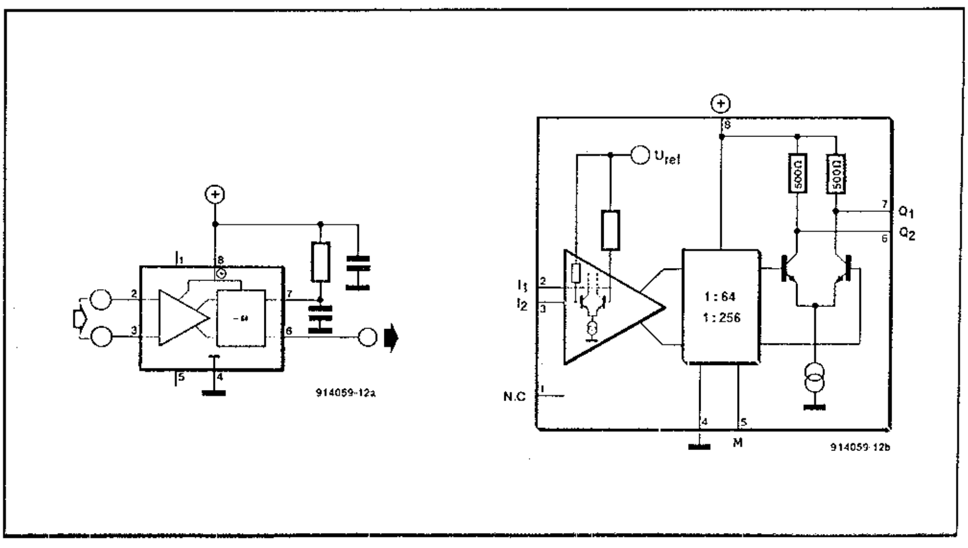

Fig. 2. Circuit diagram of the U664B (left) and the SDA4211 (right).

a sig-
pplied
l as an
ly lik
nplifi-
as the
n but
ance
he sig-
m the
ied in
emit-
llector
igger
gates,
of the
orig-
when
1000)
howr
care
ocket
used
truc-
pper
re

The input socket is a BNC type for PCB mounting; this obviates the need of screened cable at the input.

If the SDA4211 is used (IC_3), the link at JP_1 should connect the +5 V line to pin 5 of IC_2. If the U664B is used, the jumper should not be used. Nothing more can go wrong here than the scaling factor. ■

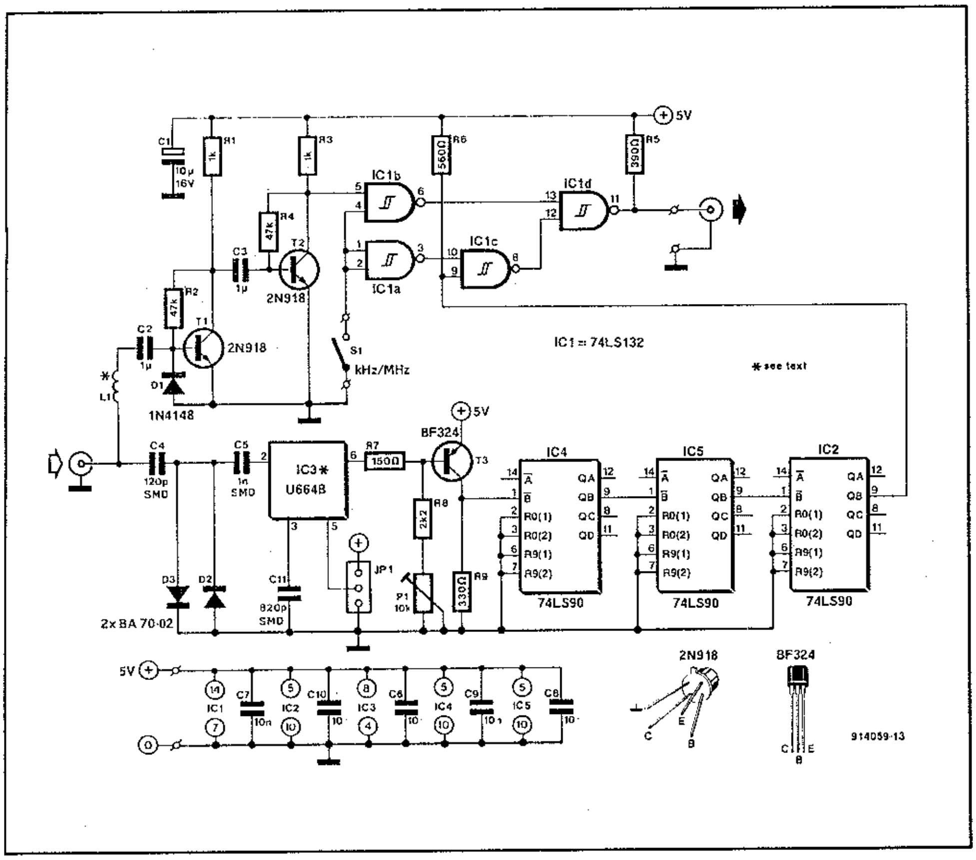

Fig. 3. Circuit diagram of the 1.3 GHz prescaler.

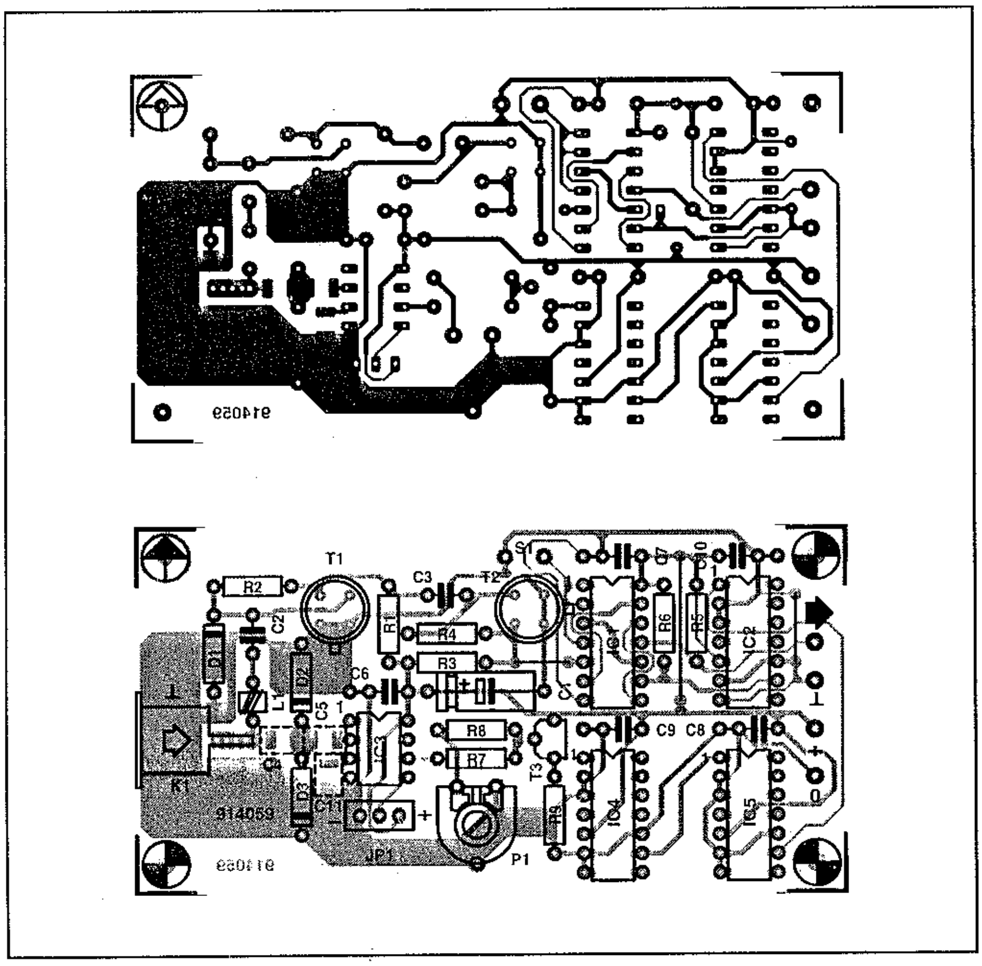

Fig. 4. Printed circuit board for the 1.3 GHz prescaler.

Brief specification

- Two switchable measurement range
 1:1000
- Upper frequency limit 1.3 GHz
- Input sensitivity <100 mV
- Compact, economical design
- Power supply 5 V
- Single board construction

Clock	74LS90 ouputs			
	Q_A	Q_D	Q_C	Q
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	1	0	0	0
6	1	0	0	1
7	1	0	1	0
8	1	0	1	1
9	1	1	0	0

PARTS LIST

Resistors:
R1, R3 = 1 kΩ
R2, R4 = 47 kΩ
R5 = 390 Ω
R6 = 560 Ω
R7 = 150 Ω
R8 = 2.2 kΩ
R9 = 330 Ω
P1 = 10 kΩ preset, horizontal

Capacitors:
C1 = 10 µF, 16 V
C2, C3 = 1 µF
C4 = 120 pF, surface mount
C5 = 1 nF, surface mount
C6–C10 = 10 nF
C11 = 820 pF, surface mount

Semiconductors:
D1 = 1N4148
D2, D3 = BAT81, BAT82 or BAT83
T1, T2 = 2N918
T3 = BF324
IC1 = 74LS132
IC2, IC4, IC5 = 74LS90
IC3 = U664B or SDA4211

Miscellaneous:
L1 = see text
S1 = single-pole on/off switch
K1 = BNC socket for PCB mountin
JP1 = 3-way terminal strip
PCB 914059

a sig-
applied
l as an
tly lik
amplifi-
as the
tor, but
l ince
he sig-

om the
tied in
emit-
llector
rigger
gates,
of the
orig-
when
1000)

hown
care
ocket
used
truc-
pper
tc

The input socket is a BNC type for PCB mounting; this obviates the need of screened cable at the input

If the SDA4211 is used (IC_3), the link at JP_1 should connect the +5 V line to pin 5 of IC_2. If the U664B is used, the jumper should not be used. Nothing more can go wrong here than the scaling factor ■

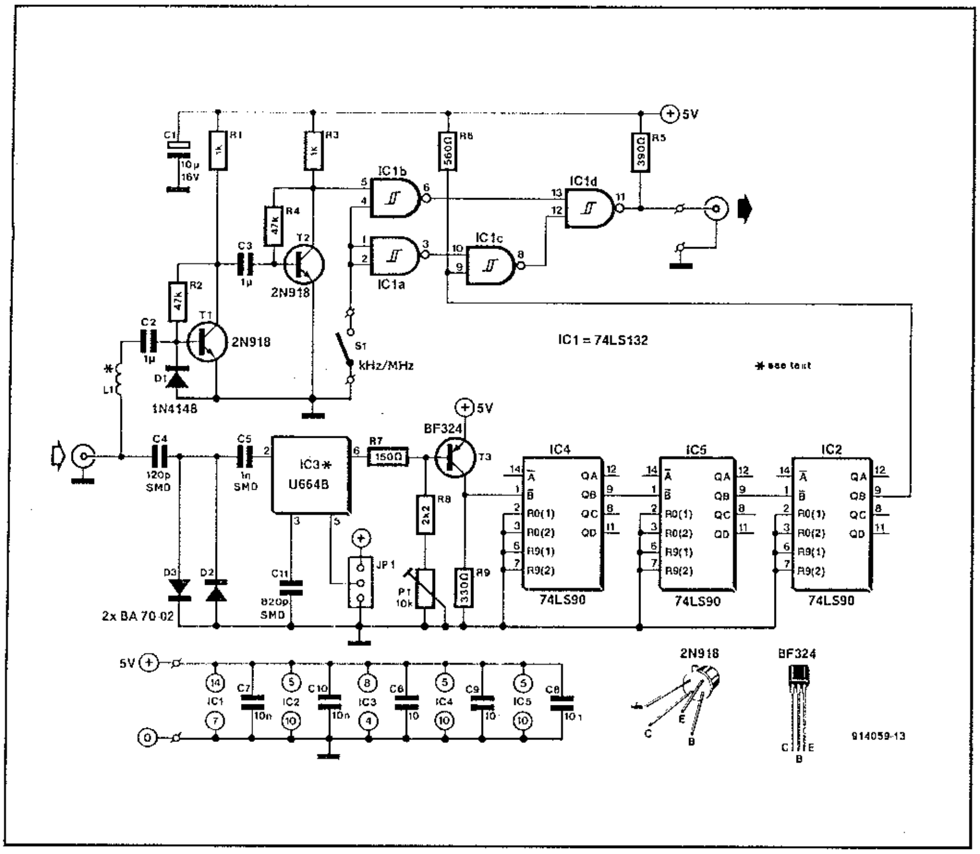

Fig. 3. Circuit diagram of the 1.3 GHz prescaler.

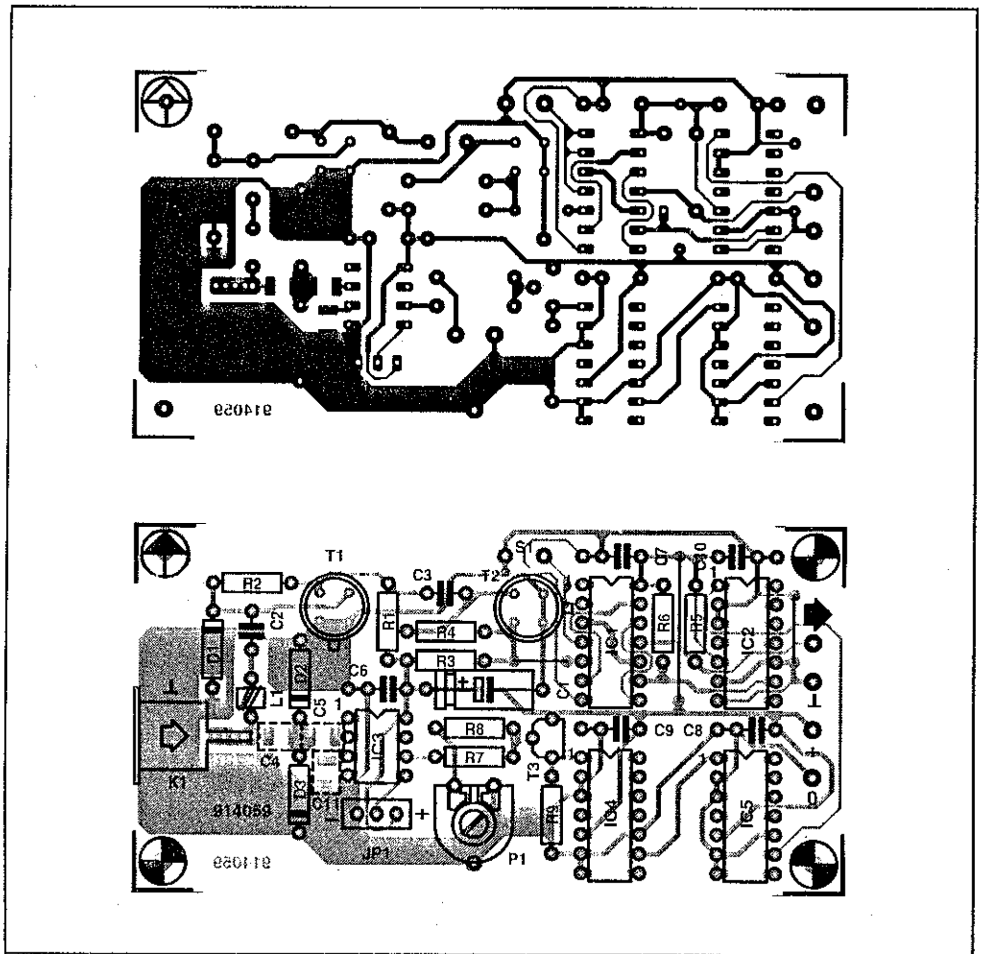

Fig. 4. Printed circuit board for the 1.3 GHz prescaler.

Brief specification

- Two switchable measurement ranges 1:1000
- Upper frequency limit 1.3 GHz
- Input sensitivity <100 mV
- Compact, economical design
- Power supply 5 V
- Single board construction

Clock	74LS90 ouputs			
	Q_A	Q_D	Q_C	Q
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	1	0	0	0
6	1	0	0	1
7	1	0	1	0
8	1	0	1	1
9	1	1	0	0

PARTS LIST

Resistors:
R1, R3 = 1 kΩ
R2, R4 = 47 kΩ
R5 = 390 Ω
R6 = 560 Ω
R7 = 150 Ω
R8 = 2.2 kΩ
R9 = 330 Ω
P1 = 10 kΩ preset, horizontal

Capacitors:
C1 = 10 µF, 16 V
C2, C3 = 1 µF
C4 = 120 pF, surface mount
C5 = 1 nF, surface mount
C6–C10 = 10 nF
C11 = 820 pF, surface mount

Semiconductors:
D1 = 1N4148
D2, D3 = BAT81, BAT82 or BAT83
T1, T2 = 2N918
T3 = BF324
IC1 = 74LS132
IC2, IC4, IC5 = 74LS90
IC3 = U664B or SDA4211

Miscellaneous:
L1 = see text
S1 = single-pole on/off switch
K1 = BNC socket for PCB mounting
JP1 = 3-way terminal strip
PCB 914059