ERICSSON TEI - R&D DIVISION

HARDWARE DEPARTMENT

TEI/TTS Carlo Mozetic

Alternative Implementation Proposal

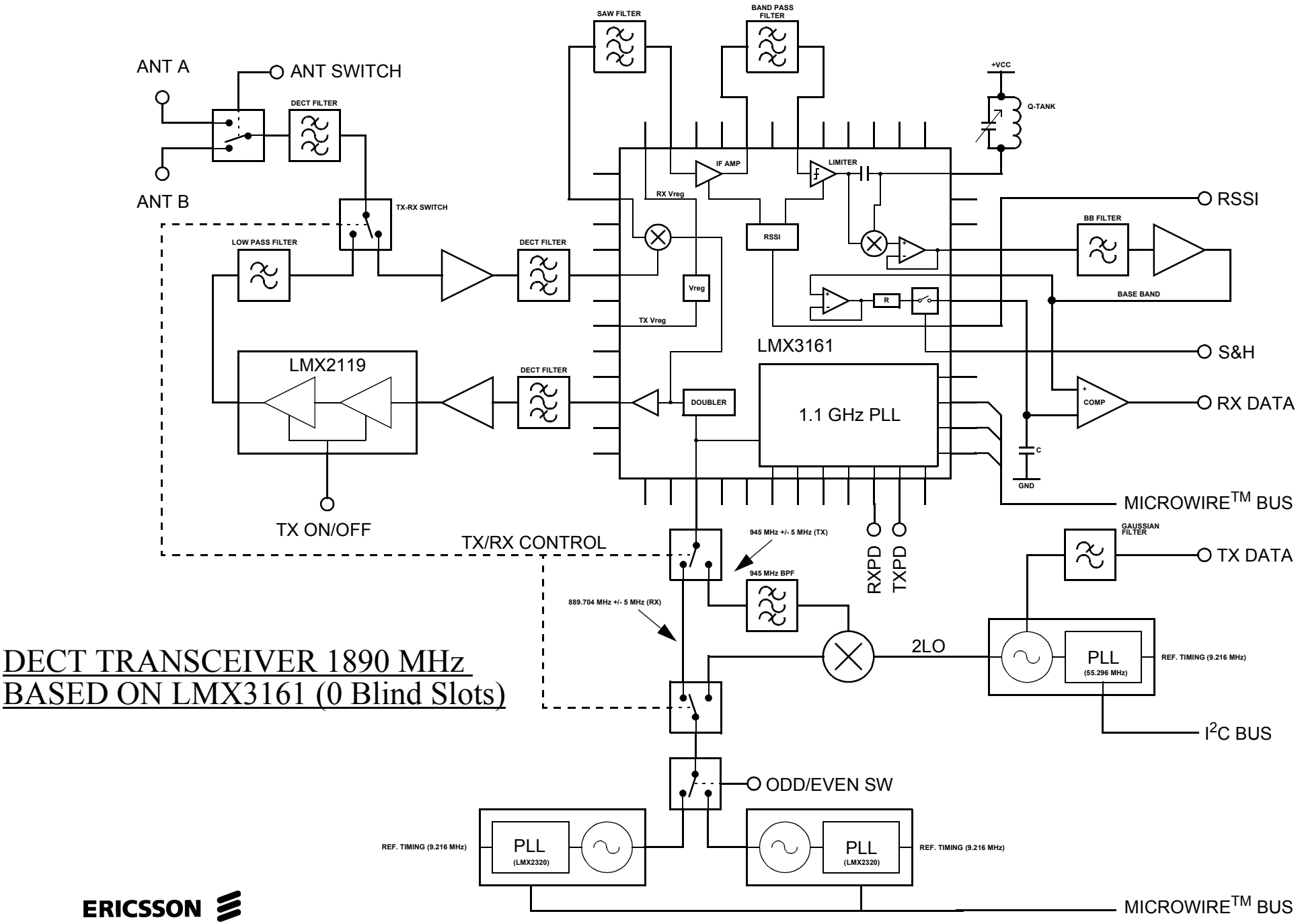
for

DRA-3500 RADIO ARCHITECTURE

SYSTEM ANALISYS

Subject	FREESET margins	Verdict	Hardware improvements	S. MARCO 2 margins	Verdict
Receiver sensitivity	-1 dB (ext. temp.)	NOK	RF bandpass filters have been changed to reduce the amount of loss before the receiver front-end.	+3.5 dB (ext. temp.)	OK
Co-channel rejection	-3 to +0.5 dB	NOK	1IF filter has been changed to increase the IF bandwidth linearity. 2IF filters have been replaced by an RC network.	+2.5 dB	OK
Adjacent channel	-2 to +2 dB	NOK	1IF filter has been changed to increase the adjacent channel rejection at IF level.	+4 to +12 dB	OK
Receiver Intermodulations	-3 to -2 dB	NOK	By changing the RF bandpass filters the gain factors of RF stages have been completely redesigned.	+2 to +4 dB	OK
Reference timing	>> +5 p.p.m.	NOK	A 2.5 p.p.m. reference timing TCXO is used insead of the XO previously adopted.	within range	OK
Emissions due to modul.	-5 dB	NOK	The PA power filtering has been changed in order to optimize the ramp-up and spurious products.	within range	OK
Synchronisation (WER) at -73 dBm with 16 bit burst	$> 5 \times 10^{-2}$	NOK	The slicer architecture has been completely redesigned. A further digital patch for BMC Asic has been included.	$< 1 \times 10^{-5}$	OK

Note: margins are related to the TBR6 limits for CTM-DECT standard applications.



DECT TRANSCEIVER 1890 MHz BASED ON LMX3161 (0 Blind Slots)

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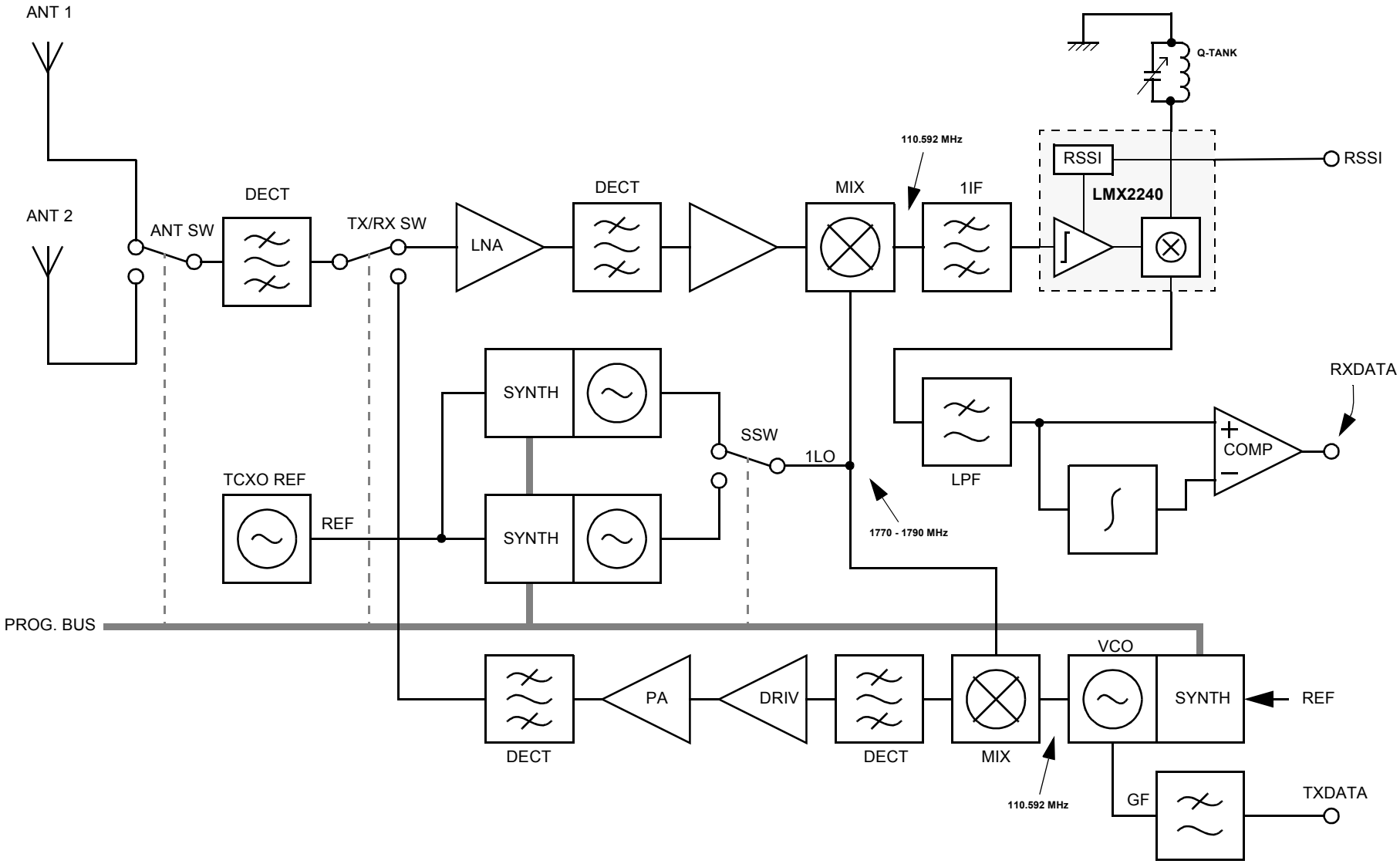
DECT TRANSCEIVER 1890 MHz BASED ON LMX2240



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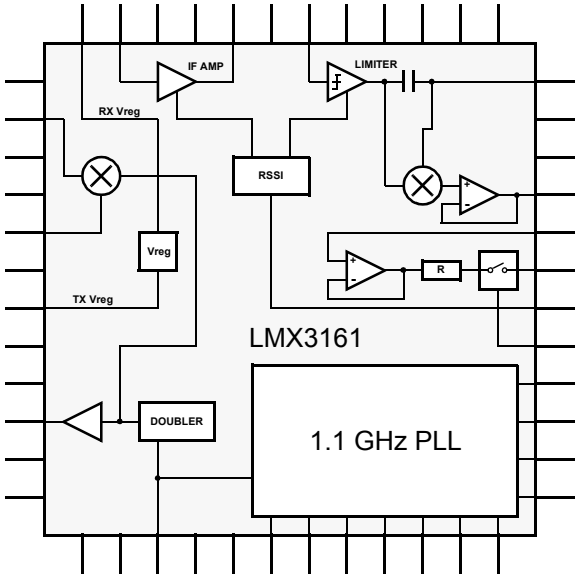
Subject	LMX3161 margins (at +25C)	LMX2240 margins (at +25C)
Receiver sensitivity	+6.5 dB	+8.5 dB
Co-channel rejection	+3.5 dB	+4.0 dB
Adjacent channel	+2 to +6 dB (with shield)	+4 to +18 dB
Receiver Intermodulations	+3.5 dB	+5.5 dB

Note: margins are related to the TBR6 limits for CTM-DECT standard applications.

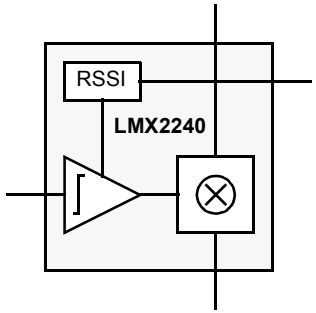
IC - DRAWBACKS

LMX3161



- **ISOLATION BETWEEN MIXER OUTPUT PIN AND IF AMPLIFIER INPUT PIN IS TOO LOW.**
- **THE PLL GENERATES AN INTERNAL SPURIOUS EMISSION WHICH IN SOME CASES AFFECTS IF S/N PERFORMANCE. THE PLL CANNOT BE COMPLETELY DISABLED BY FORCING EXTERNAL PINS.**
- **SOME PARAMETERS ARE TO BE ENTERED ONLY BY SOFTWARE (e.g. output level and offset). NO DEFAULT VALUES CAN BE USED.**
- **THE INTERNAL REGISTERS SHALL BE CONTINOUSLY REFRESHED, BECAUSE THERE ARE NO STATUS INDICATORS. AN EXTERNAL EMI DISTURBANCE MAY CAUSE THE RESET OF SOME REGISTERS.**
- **DELAY ELEMENTS IN THE DETECTOR SHALL BE TUNED.**

LMX2240



- **DELAY ELEMENTS IN THE DETECTOR SHALL BE TUNED.**
- **THIS COMPONENT WILL NOT BE AVAILABLE AFTER 2nd QUARTER OF 1999.**

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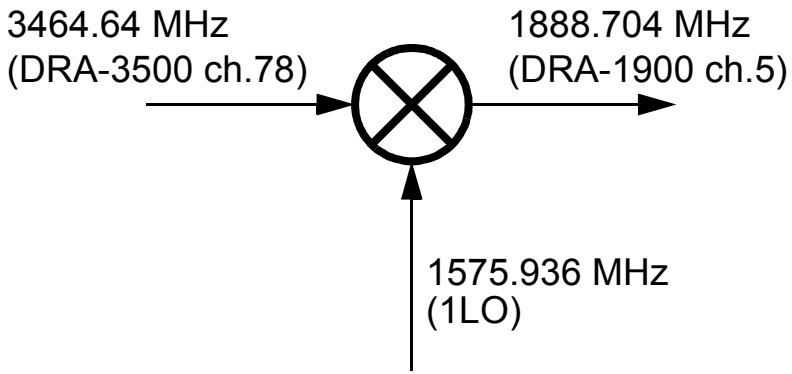
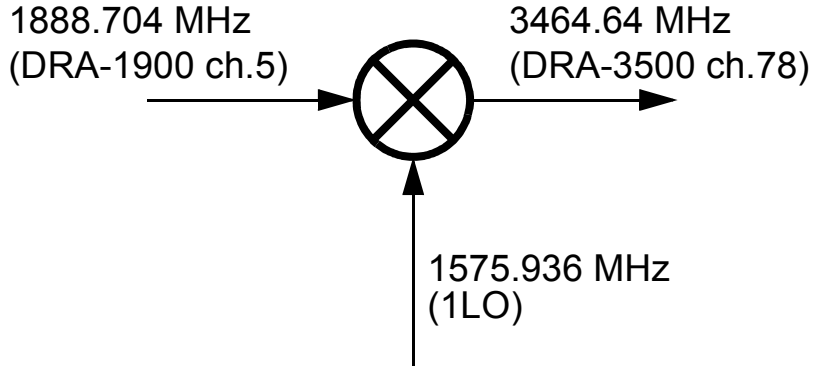
ALTERNATIVE 3

DOWN CONVERSION



UP CONVERSION

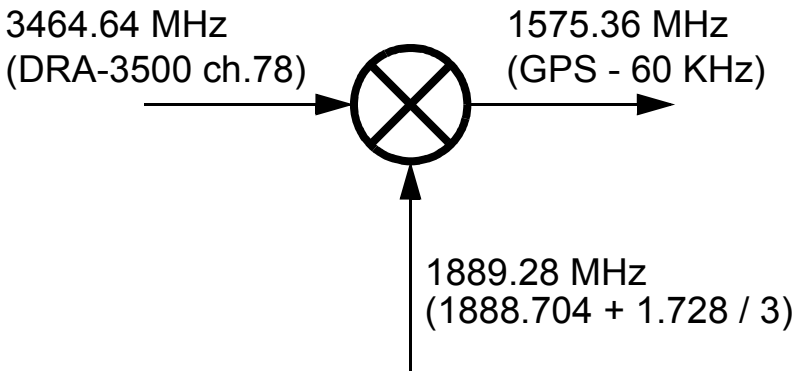


2nd RF-1LO harmonic at
3400 MHz - 248.128 MHz

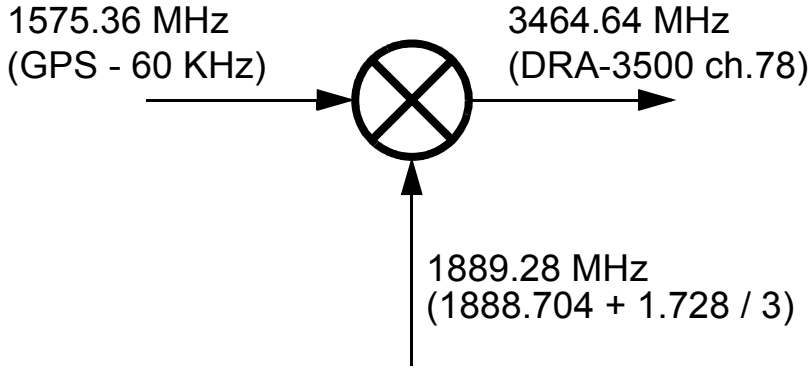
2nd RF-2LO harmonic at
3600 MHz + 177.408 MHz

ALTERNATIVE TEI

DOWN CONVERSION



UP CONVERSION



2nd RF-1LO harmonic at
3600 MHz + 178.56 MHz

2nd RF-2LO harmonic at
3400 MHz - 249.28 MHz

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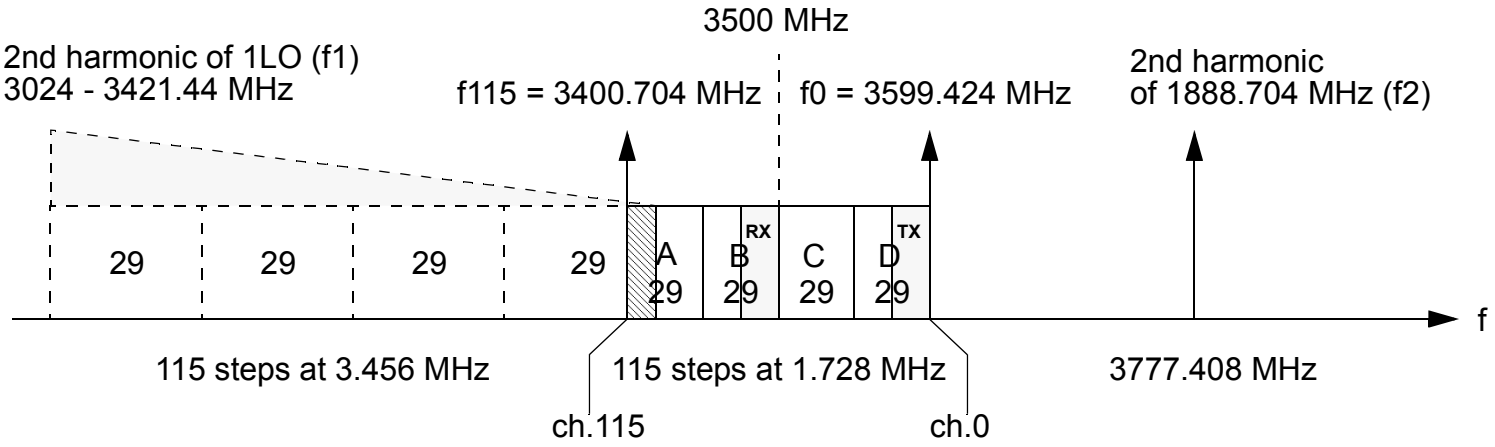
FREQUENCY DISTRIBUTION SCHEME FOR ALTERNATIVE 3



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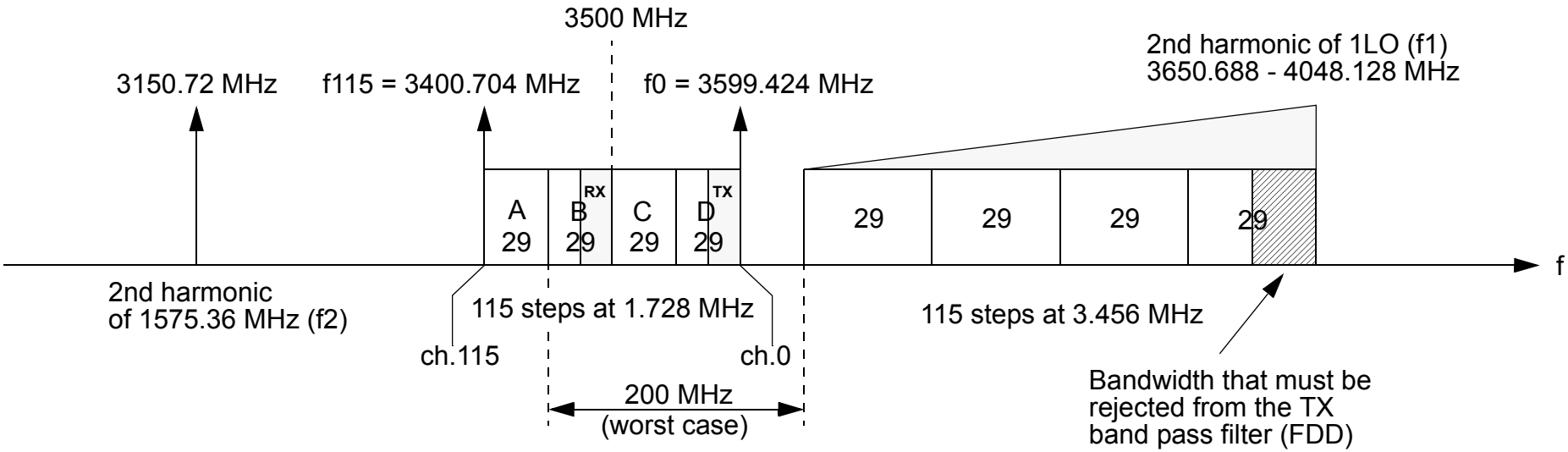
FREQUENCY DISTRIBUTION SCHEME FOR TEI ALTERNATIVE



PRODUCTS WHICH COULD AFFECT UP CONVERTER OPERATIONS :

A band	**6f2 - 7f1**
	8f2 - 5f1
B band	**5f2 - 6f1**
	7f2 - 4f1
C band	**4f2 - 5f1**
D band	**4f2 - 5f1**

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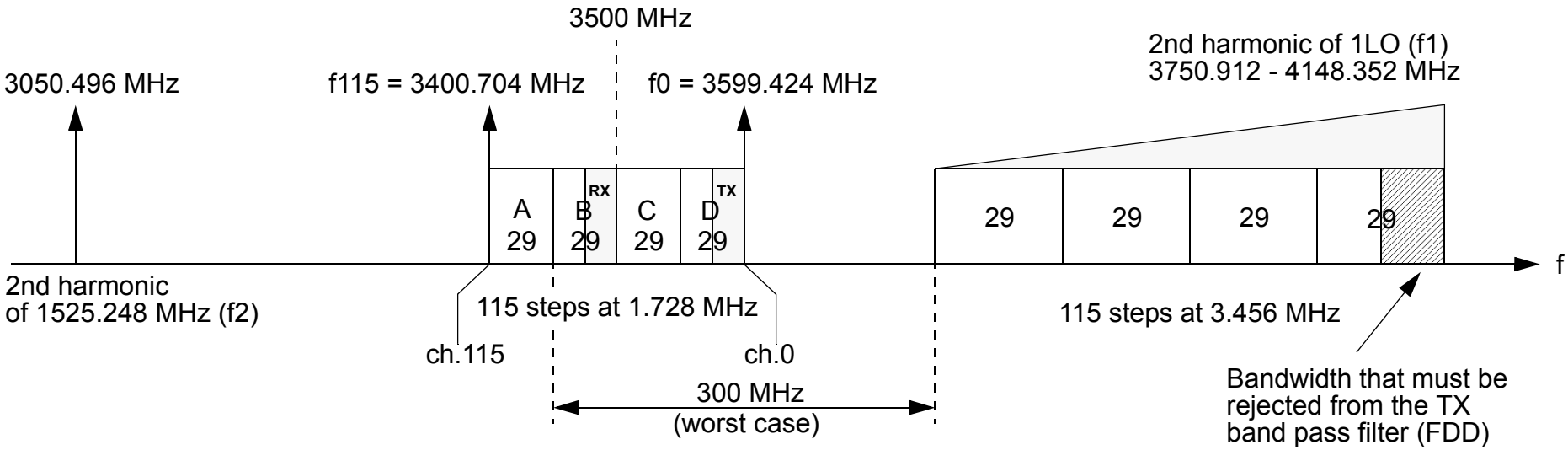
ANOTHER POSSIBLE FREQUENCY DISTRIBUTION SCHEME



PRODUCTS WHICH COULD AFFECT UP CONVERTER OPERATIONS :

A band	**6f2 - 3f1**
	4f2 - 5f1
C band	**3f2 - 4f1**
D band	**5f2 - 2f1**
	3f2 - 4f1
	9f2 - 5f1
	7f2 - 7f1

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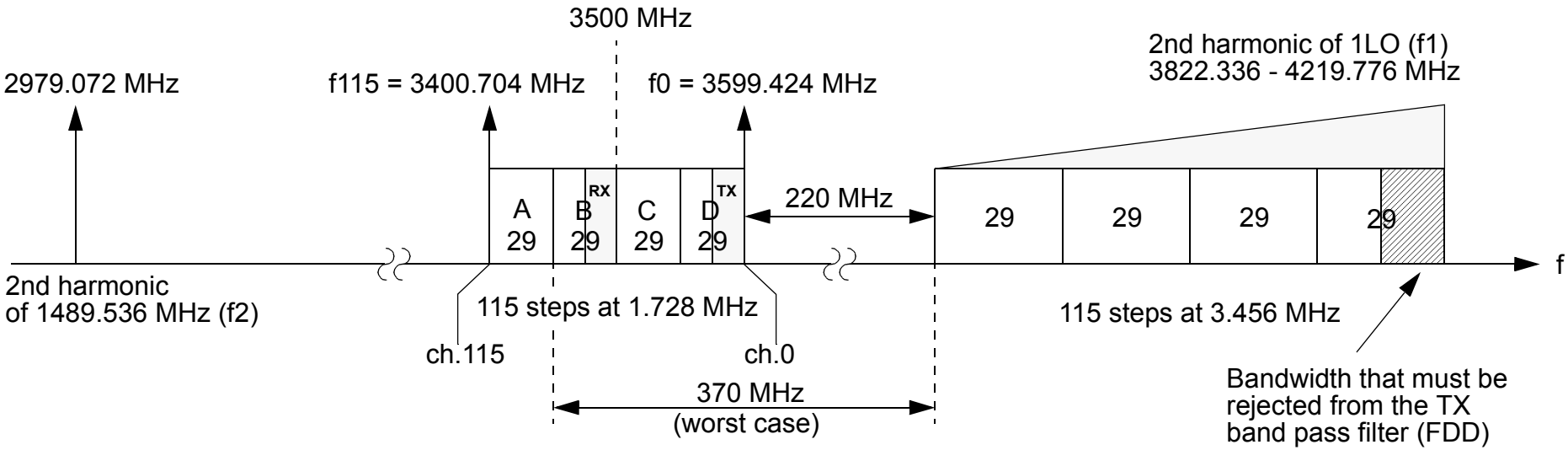
ANOTHER POSSIBLE FREQUENCY DISTRIBUTION SCHEME



PRODUCTS WHICH AFFECT UP CONV. BY USING SINGLE BAND RF FILTERS : 2F2 - 3F1, Δ = 45 MHz !!!

PRODUCTS WHICH COULD AFFECT UP CONVERTER OPERATIONS :

A band	**3f2 - 4f1**
B band	**5f2 - 2f1**
	3f2 - 4f1
	9f2 - 5f1
	7f2 - 7f1
C band	**3f2 - 4f1**
	6f2 - 6f1
D band	**8f2 - 4f1**
	6f2 - 6f1

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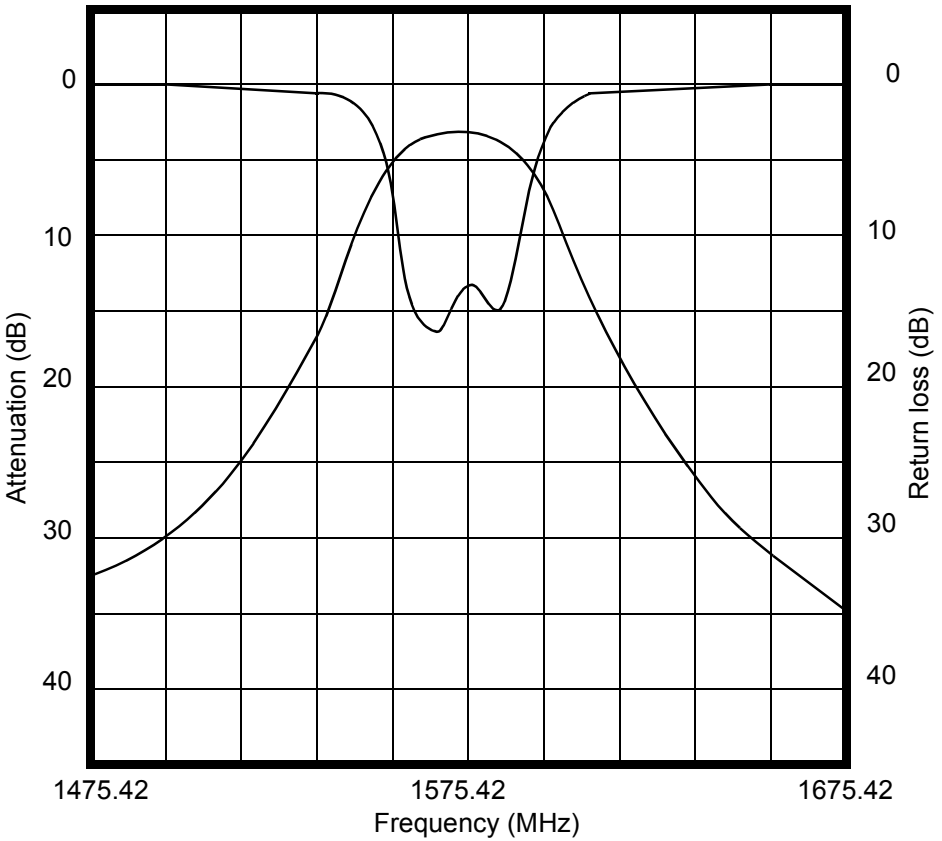
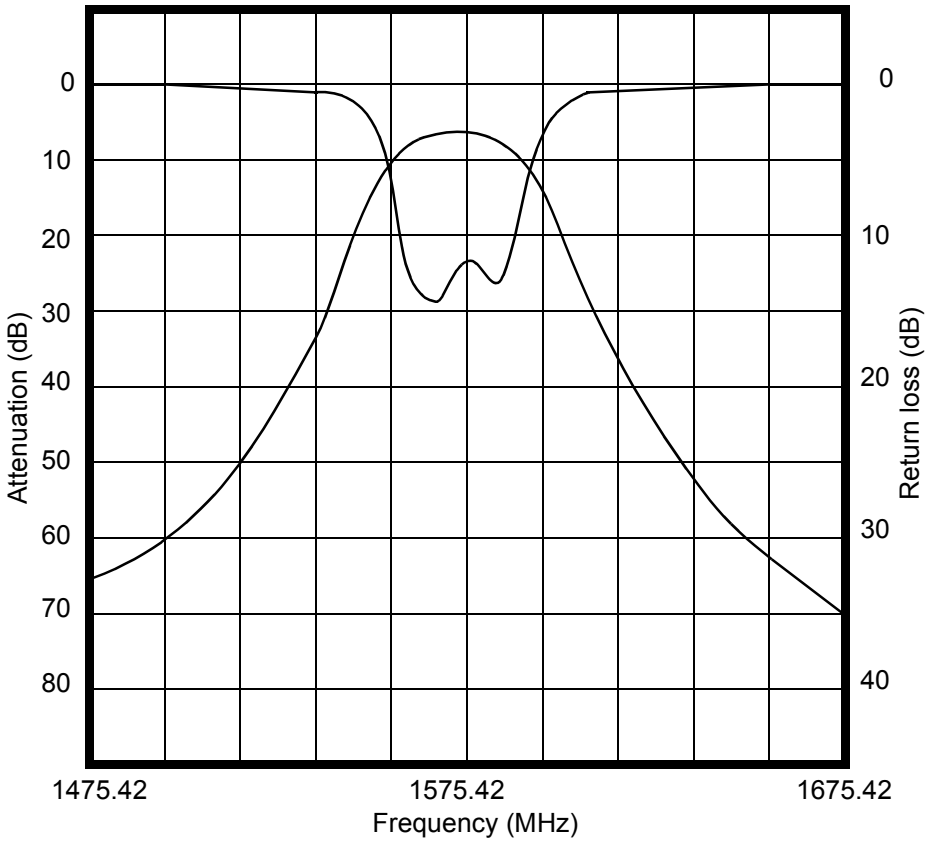
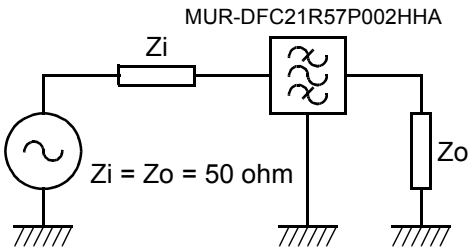
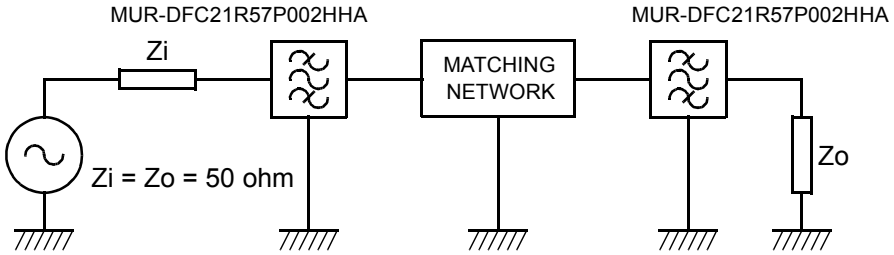




DOWN CONVERSION



UP CONVERSION



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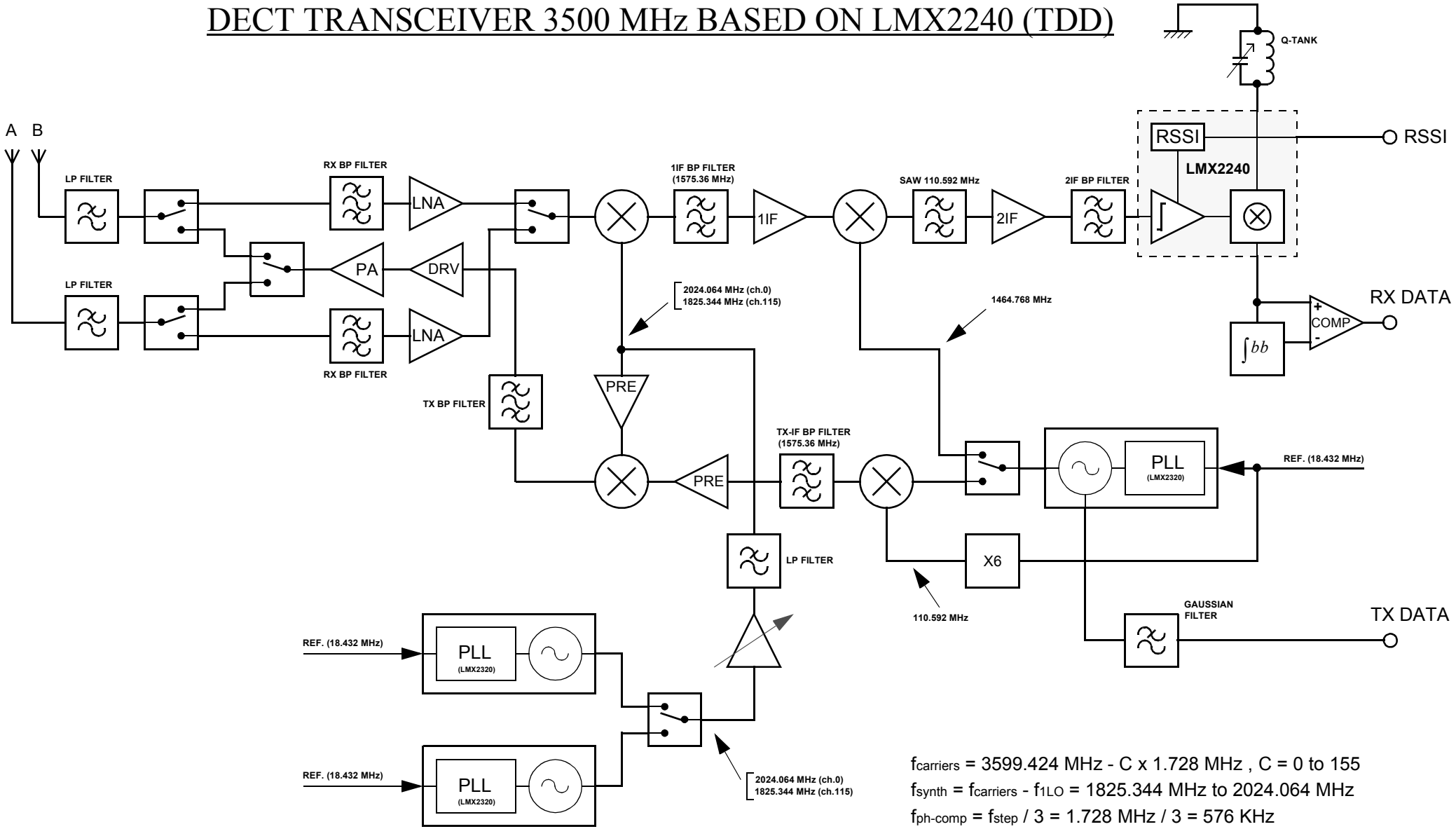
DECT TRANSCEIVER 3500 MHz BASED ON LMX2240 (TDD)



$f_{carriers}$ = 3599.424 MHz - C x 1.728 MHz , C = 0 to 155

$f_{synth} = f_{carriers} - f_{1LO}$ = 1825.344 MHz to 2024.064 MHz

$f_{ph\text{-}comp} = f_{step} / 3$ = 1.728 MHz / 3 = 576 KHz

$f_{2LO} = f_{1LO} - f_{IF2}$ = 1575.36 - 110.592 = 1464.768 MHz

$f_{ref} = f_{ph\text{-}comp}$ x 32 = 576 KHz x 32 = 18.432 MHz (16 x bit-rate)

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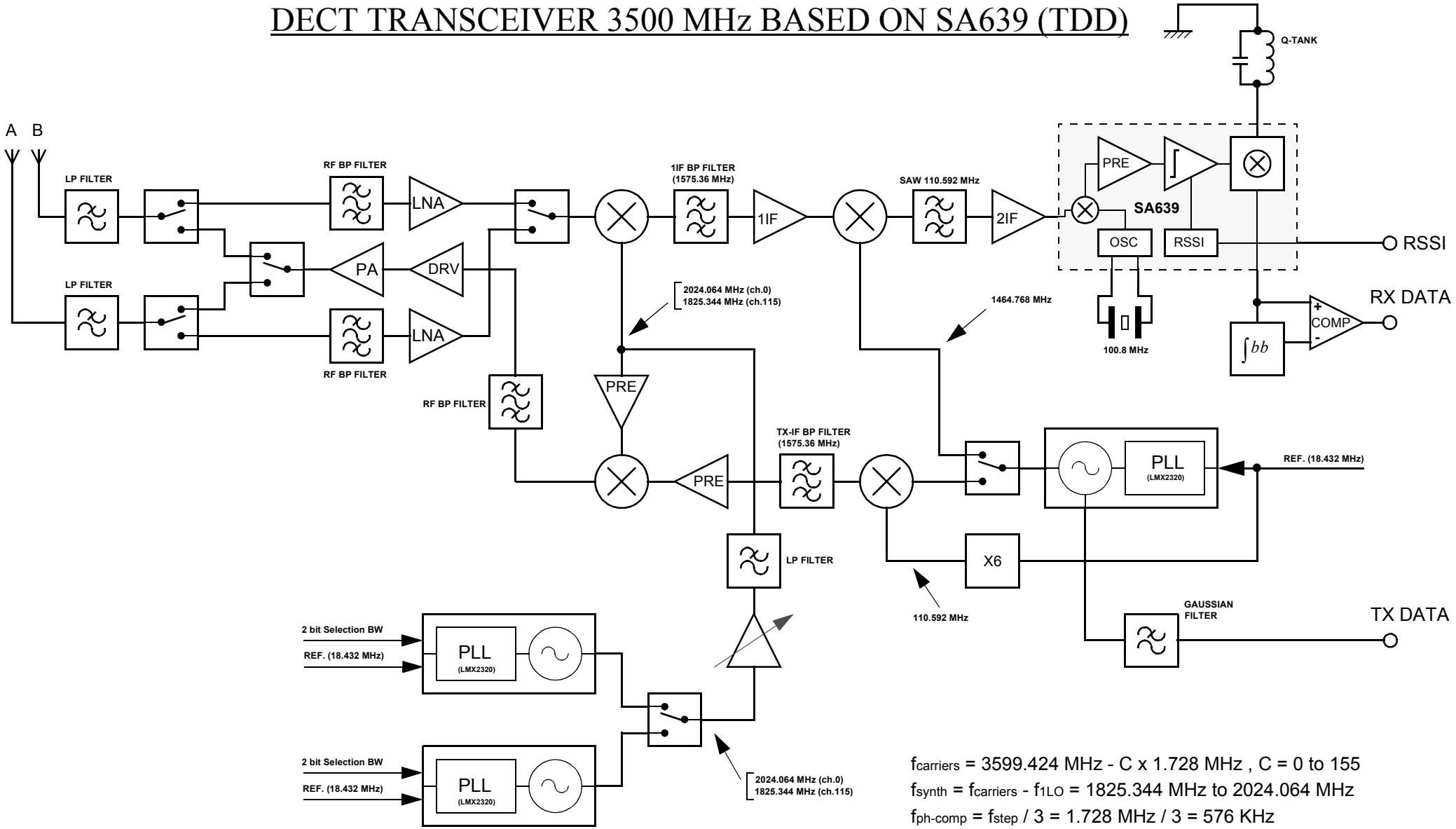
DECT TRANSCEIVER 3500 MHz BASED ON SA639 (TDD)



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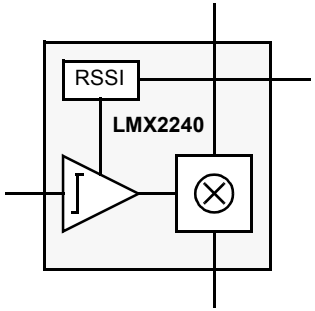
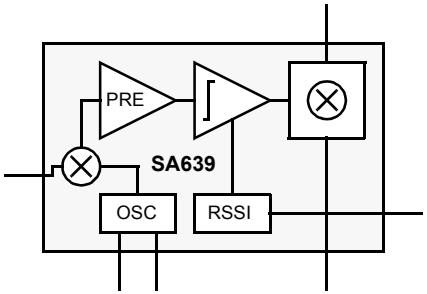
IC - FEATURES AND DRAWBACKS

LMX2240



- **HIGH PERFORMANCE IF CHIP.**
- **DELAY ELEMENTS IN THE DETECTOR SHALL BE TUNED.**
- **THIS COMPONENT WILL NOT BE AVAILABLE AFTER 2nd QUARTER OF 1999.**
- **USELESS FOR DIGITAL SEMI COHERENT DEMODULATORS.**

SA639



- **HIGH PERFORMANCE IF CHIP.**
- **THE LIMITER OUTPUT IS AVAILABLE; USEFUL FOR DIGITAL DEMODULATORS.**
- **NO DELAY ELEMENTS IN THE DETECTOR SHALL BE TUNED (ANALOG DEMODULATION).**
- **WIDE DYNAMIC RANGE OF RSSI OUTPUT.**
- **ANOTHER INTERNAL DOWN CONVERSION; THIS COULD AFFECTS THE B.B. DISTORTION.**

ALTERNATIVES - FEATURES AND DRAWBACKS

ALTERNATIVE 1

- ○ **ONLY TWO DOWN CONVERSIONS. THE CHANNEL SELECTION PERFORMED AT 1st IF INTERSTAGE CAN IMPROVES THE RECEIVER INTERMODULATION PERFORMANCES BY USING A MIXER WITH HIGH IP3 VALUE.**
- ○ **BETTER SUPPRESSION OF LO FREQUENCY DUE TO BALANCED MIXING ARCHITECTURE.**
- ○ **DIGITAL MODEM (π/4DQPSK) EASIER TO IMPLEMENT.**
- ● **RF-LO ARCHITECTURE IS BASED ON "HORUS" PERFORMANCES. ITS FIRST RELEASE WILL BE AVAILABLE IN THE NEXT FUTURE.**
- ● **HORUS FRACTIONAL SYNTHESIS COULDN'T MATCH THE DRA-3500 REQUIREMENTS (VCOs BANDWIDTH AND FDD LOCKING TIME).**
- ● **THE CHARACTERISTICS OF THE SAW FILTER AREN'T EASY TO IMPLEMENT. THIS CAN AFFECTS THE MAIN RECEIVER PERFORMANCES.**
- ● **RF-LO FREQUENCY TOO HIGH. THIS MEANS THAT THE PLL STAGE SHALL BE IMPLEMENTED BY USING THE SAME TECHNOLOGY OF THE FRONT-END.**
- ● **FOR ANALOG DEMODULATION ANOTHER IC SHALL BE IMPLEMENTED.**

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ALTERNATIVE TEI

- ○ **ALL COMPONENTS ARE AVAILABLE NOW.**
- ○ **THE BEST RECEIVER PERFORMANCE ARE ACHIEVABLE BY USING THE SAW FILTER ALREADY KNOWN.**
- ○ **THE 3.5 GHz STAGES ARE REDUCED TO THE ESSENTIAL, SO THE RISKS ARE REDUCED TOO.**
- ● **THE CHANNEL SELECTION PERFORMED AT 2nd IF INTERSTAGE WILL AFFECTS THE RECEIVER INTERMODULATION REJECTION CHARACTERISTICS.**
- ● **ANOTHER INTERNAL DOWN CONVERSION; THIS COULD AFFECTS THE B.B. DISTORTION.**
- ● **BETTER REJECTION PERFORMANCE OF TX BAND PASS FILTER IS NECESSARY.**

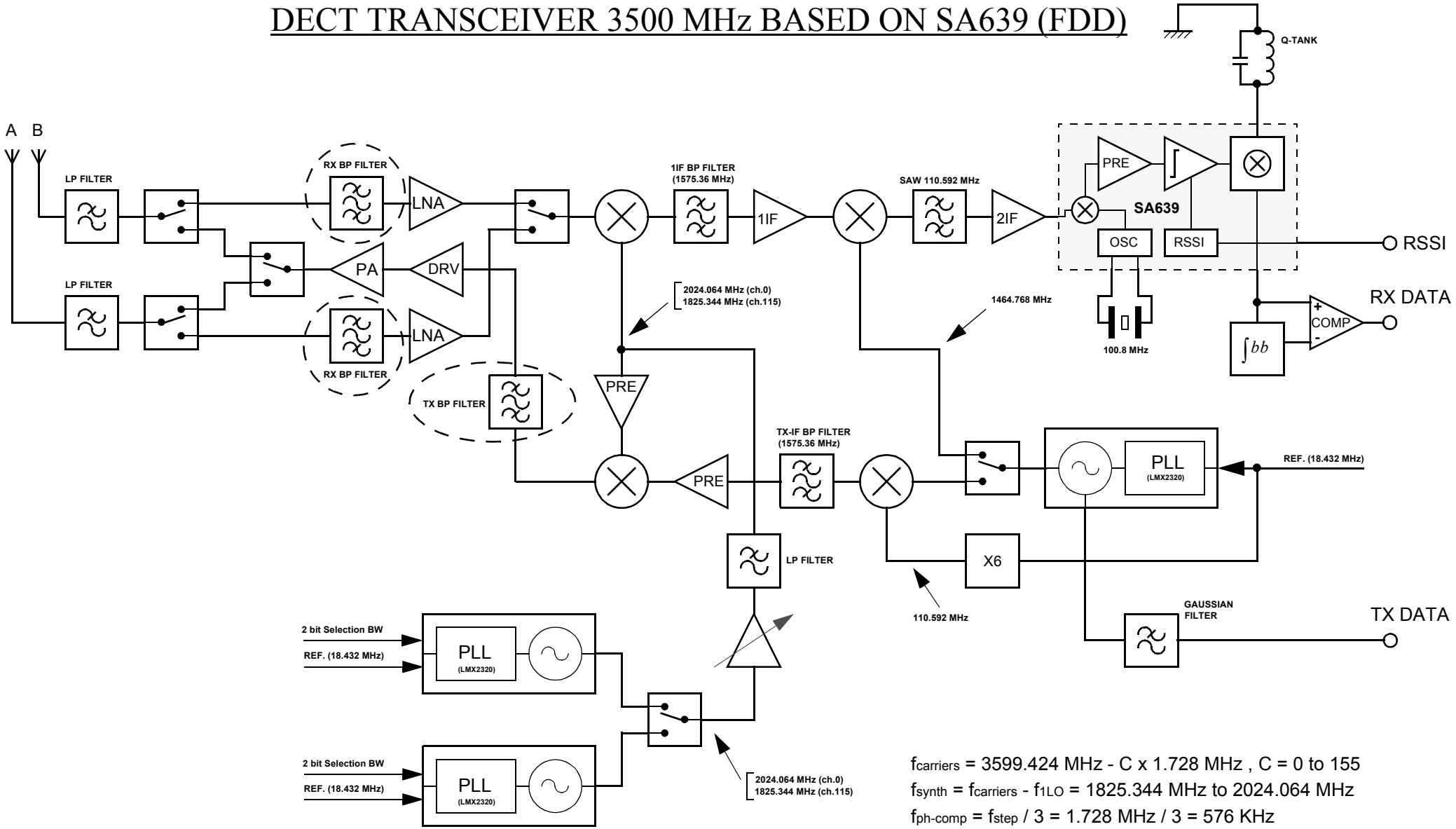
IMPLEMENTATION SUGGESTIONS

The emissions due to modulation performances will be very difficult to achieve because of the power requirements (6 dB more than DECT standard applications).

This means that the phase noise parameter on TX chain shall be reduced even if the radio bandwidth is enlarged (50 MHz instead of 20 MHz).

So, it is strongly recommended to use only low noise components and special VCOs with very low phase noise and two bits to select the operating bandwidth.

DECT TRANSCEIVER 3500 MHz BASED ON SA639 (FDD)



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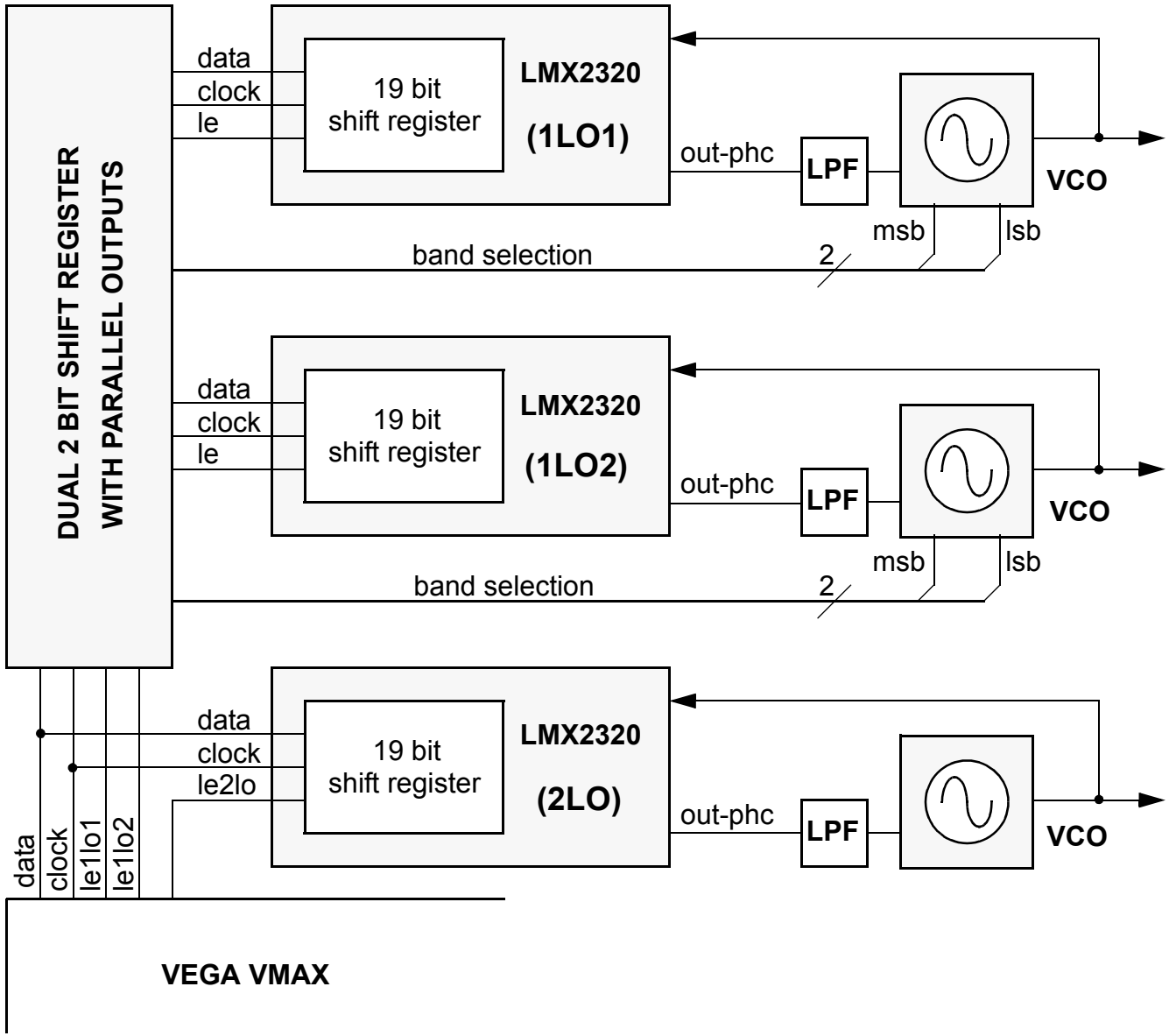
EXAMPLE OF FOUR BAND VCOs ARCHITECTURE



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Ch.	Frf (MHz)	Flo (MHz)	[(PxB)+A]	P	B	A	fref/R (KHz)
0	3599.424	2024.064	3514	64	54	58	576
1	3597.696	2022.336	3511	64	54	55	576
2	3595.968	2020.608	3508	64	54	52	576
3	3594.24	2018.88	3505	64	54	49	576
4	3592.512	2017.152	3502	64	54	46	576
5	3590.784	2015.424	3499	64	54	43	576
6	3589.056	2013.696	3496	64	54	40	576
7	3587.328	2011.968	3493	64	54	37	576
8	3585.6	2010.24	3490	64	54	34	576
9	3583.872	2008.512	3487	64	54	31	576
10	3582.144	2006.784	3484	64	54	28	576
11	3580.416	2005.056	3481	64	54	25	576
12	3578.688	2003.328	3478	64	54	22	576
13	3576.96	2001.6	3475	64	54	19	576
14	3575.232	1999.872	3472	64	54	16	576
15	3573.504	1998.144	3469	64	54	13	576
16	3571.776	1996.416	3466	64	53	74	576
17	3570.048	1994.688	3463	64	53	71	576
18	3568.32	1992.96	3460	64	53	68	576
19	3566.592	1991.232	3457	64	53	65	576
20	3564.864	1989.504	3454	64	53	62	576
21	3563.136	1987.776	3451	64	53	59	576
22	3561.408	1986.048	3448	64	53	56	576
23	3559.68	1984.32	3445	64	53	53	576
24	3557.952	1982.592	3442	64	53	50	576
25	3556.224	1980.864	3439	64	53	47	576
26	3554.496	1979.136	3436	64	53	44	576
27	3552.768	1977.408	3433	64	53	41	576
28	3551.04	1975.68	3430	64	53	38	576

Ch.	Frf (MHz)	Flo (MHz)	[(PxB)+A]	P	B	A	fref/R (KHz)
29	3549.312	1973.952	3427	64	52	99	576
30	3547.584	1972.224	3424	64	52	96	576
31	3545.856	1970.496	3421	64	52	93	576
32	3544.128	1968.768	3418	64	52	90	576
33	3542.4	1967.04	3415	64	52	87	576
34	3540.672	1965.312	3412	64	52	84	576
35	3538.944	1963.584	3409	64	52	81	576
36	3537.216	1961.856	3406	64	52	78	576
37	3535.488	1960.128	3403	64	52	75	576
38	3533.76	1958.4	3400	64	52	72	576
39	3532.032	1956.672	3397	64	52	69	576
40	3530.304	1954.944	3394	64	52	66	576
41	3528.576	1953.216	3391	64	52	63	576
42	3526.848	1951.488	3388	64	52	60	576
43	3525.12	1949.76	3385	64	52	57	576
44	3523.392	1948.032	3382	64	52	54	576
45	3521.664	1946.304	3379	64	52	51	576
46	3519.936	1944.576	3376	64	52	48	576
47	3518.208	1942.848	3373	64	52	45	576
48	3516.48	1941.12	3370	64	52	42	576
49	3514.752	1939.392	3367	64	52	39	576
50	3513.024	1937.664	3364	64	52	36	576
51	3511.296	1935.936	3361	64	52	33	576
52	3509.568	1934.208	3358	64	52	30	576
53	3507.84	1932.48	3355	64	52	27	576
54	3506.112	1930.752	3352	64	52	24	576
55	3504.384	1929.024	3349	64	52	21	576
56	3502.656	1927.296	3346	64	52	18	576
57	3500.928	1925.568	3343	64	52	15	576

Ch.	Frf (MHz)	Flo (MHz)	[(PxB)+A]	P	B	A	fref./R (KHz)
58	3499.2	1923.84	3340	64	51	76	576
59	3497.472	1922.112	3337	64	51	73	576
60	3495.744	1920.384	3334	64	51	70	576
61	3494.016	1918.656	3331	64	51	67	576
62	3492.288	1916.928	3328	64	51	64	576
63	3490.56	1915.2	3325	64	51	61	576
64	3488.832	1913.472	3322	64	51	58	576
65	3487.104	1911.744	3319	64	51	55	576
66	3485.376	1910.016	3316	64	51	52	576
67	3483.648	1908.288	3313	64	51	49	576
68	3481.92	1906.56	3310	64	51	46	576
69	3480.192	1904.832	3307	64	51	43	576
70	3478.464	1903.104	3304	64	51	40	576
71	3476.736	1901.376	3301	64	51	37	576
72	3475.008	1899.648	3298	64	51	34	576
73	3473.28	1897.92	3295	64	51	31	576
74	3471.552	1896.192	3292	64	50	92	576
75	3469.824	1894.464	3289	64	50	89	576
76	3468.096	1892.736	3286	64	50	86	576
77	3466.368	1891.008	3283	64	50	83	576
78	3464.64	1889.28	3280	64	50	80	576
79	3462.912	1887.552	3277	64	50	77	576
80	3461.184	1885.424	3274	64	50	74	576
81	3459.456	1884.096	3271	64	50	71	576
82	3457.728	1882.368	3268	64	50	68	576
83	3456	1880.64	3265	64	50	65	576
84	3454.272	1878.912	3262	64	50	62	576
85	3452.544	1877.184	3259	64	50	59	576
86	3450.816	1875.456	3256	64	50	56	576

Ch.	Frf (MHz)	Flo (MHz)	[(PxB)+A]	P	B	A	fref/R (KHz)
87	3449.088	1873.728	3253	64	49	117	576
88	3447.36	1872	3250	64	49	114	576
89	3445.632	1870.272	3247	64	49	111	576
90	3443.904	1868.544	3244	64	49	108	576
91	3442.176	1866.816	3241	64	49	105	576
92	3440.448	1865.088	3238	64	49	102	576
93	3438.72	1863.36	3235	64	49	99	576
94	3436.992	1861.632	3232	64	49	96	576
95	3435.264	1859.904	3229	64	49	93	576
96	3433.536	1858.176	3226	64	49	90	576
97	3431.808	1856.448	3223	64	49	87	576
98	3430.08	1854.72	3220	64	49	84	576
99	3428.352	1852.992	3217	64	49	81	576
100	3426.624	1851.264	3214	64	49	78	576
101	3424.896	1849.536	3211	64	49	75	576
102	3423.168	1847.808	3208	64	49	72	576
103	3421.44	1846.08	3205	64	49	69	576
104	3419.712	1844.352	3202	64	49	66	576
105	3417.984	1842.624	3199	64	49	63	576
106	3416.256	1840.896	3196	64	49	60	576
107	3414.528	1839.168	3193	64	49	57	576
108	3412.8	1837.44	3190	64	49	54	576
109	3411.072	1835.712	3187	64	49	51	576
110	3409.344	1833.984	3184	64	49	48	576
111	3407.616	1832.256	3181	64	49	45	576
112	3405.888	1830.528	3178	64	49	42	576
113	3404.16	1828.8	3175	64	49	39	576
114	3402.432	1827.072	3172	64	49	36	576
115	3400.704	1825.344	3169	64	49	33	576