	TTC UPGRADE		Test report	
PH/ESS document No:	Created :	4.12.2006	Page	1 of 27
PH-ESS-12-06	Modified:	7.12.06	Rev.No.	1

USER MANUAL

TTC upgrade system

TEST REPORT

Summary:

RF_Tx -> RF_Rx -> RF2TTC typical results for BC transmission and Orbit

	Bunch Clock		**Orbit**			
	Skew versus source	Cy2Cy	Output Pulse width	Skew of the Orbit_out versus BCout	Orbit rising edge	Orbit falling edge
Source Std Dev		11ps rms				
Std Dev	16.6ps rms	6.25ps rms	5.43ps rms	9ps rms	4.73ps rms	7.45ps rms
pkpk	110ps pkpk	42ps pkpk	30ps pkpk	60ps rms	50ps pkpk	42ps pkpk

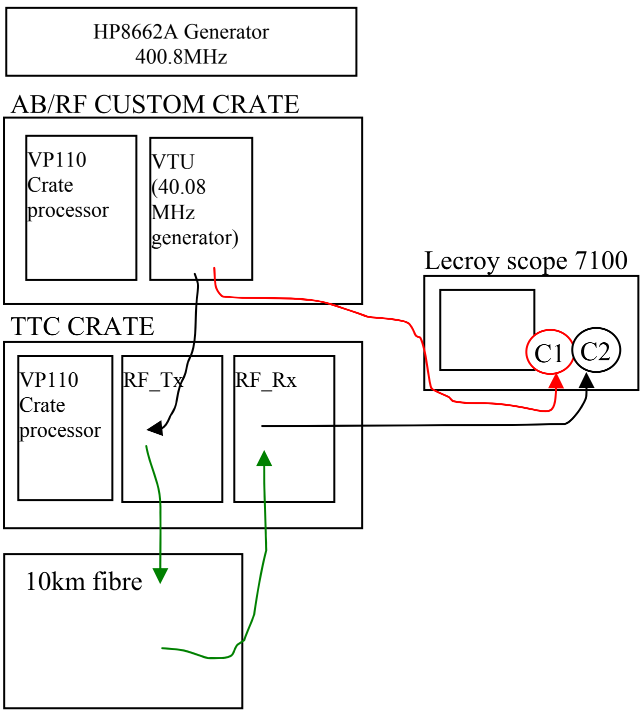
Prepared by :	***Checked by :***	***Approved by :***
Sophie BARON, PH/ESS		

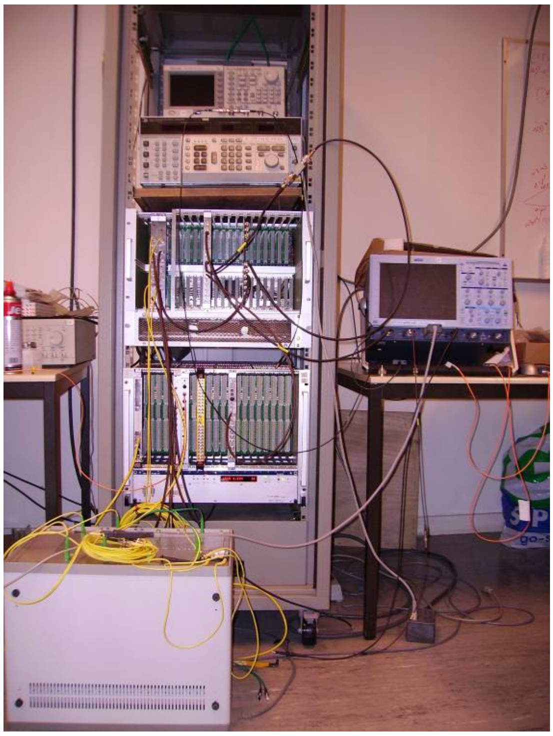
for information, you can contact :		Tel.	Fax.	E-Mail
	Sophie Baron	+41.22.7677339	+41.22.7678925	**sophie.baron@cern.ch**

TABLE OF CONTENTS

1 DIGITAL LINKS TESTS

1.1 SETUP DESCRIPTION





Various tests were made with different transmitters and receivers. The monitored parameters were skew jitter, period jitter on 50 to 100 us, cycle-to-cycle jitter, and rising edge slope.

The tested transmitters were OCP-STX03 and OCP-STX24 for the digital modules and MITEQ LBL-3 for the analogue modules.

On the receiver side, we tested the OCP-SRX03, OCP-SRX24 and the TRR-1B43-000 for the digital boards, and the MITEQ LBL3 Rx for the analogue.

The tested signals were the 40MHz square clock, the 5ns orbit pulse and the 400MHz sine wave clock.

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	40MHz	40MHz	40MHz, Pulse	-
OCP24-STX	40MHz	40MHz, 400MHz	40MHz	-
LBL3- Tx	-	-	-	40MHz, 400MHz

1.2 40MHz TRANSMISSION

Here are two plots obtained using the Lecroy wavepro 7100. All the results gathered in tables in the following sections integrate more samples (between 30k and 100k) to ensure more reliable statistics. The plots for these types of measurements are visually not interesting because of the bigger time scale (around 10us per division).

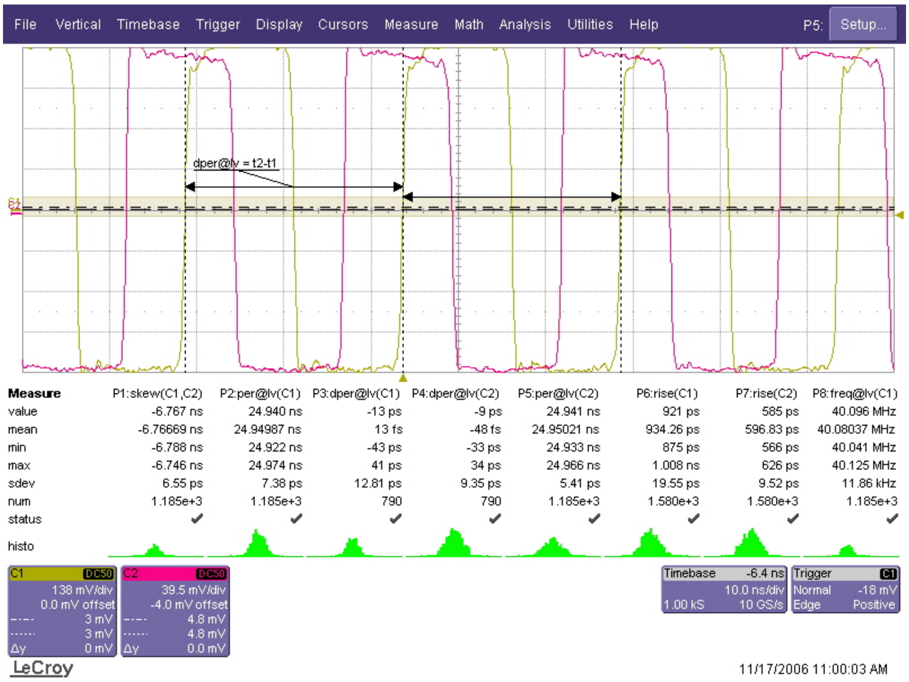


Figure 1: Analog 40MHz versus VTU source

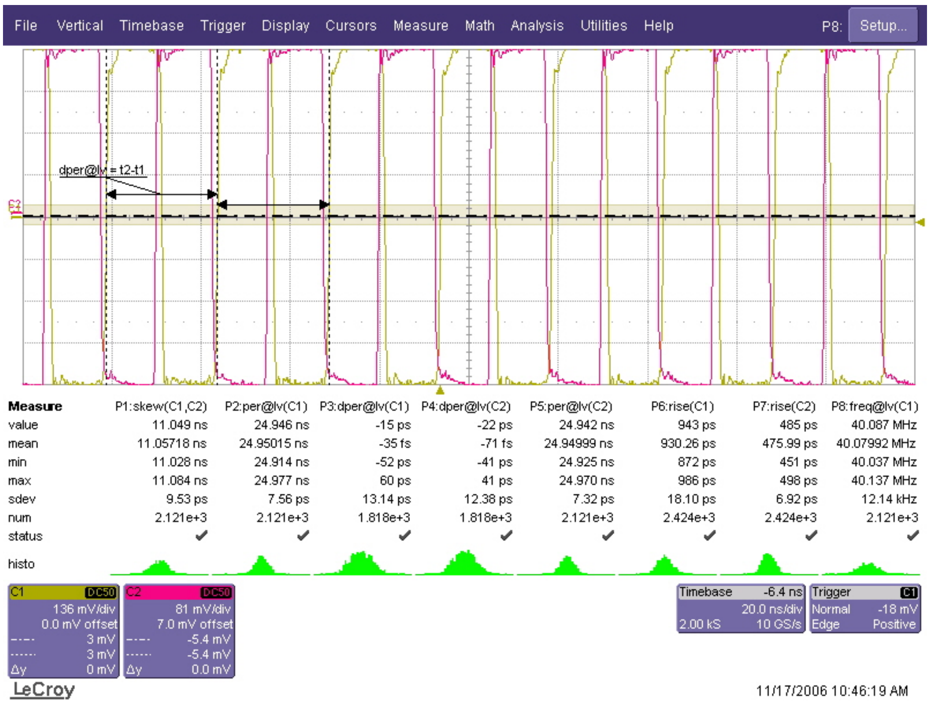


Figure 2: OCP03-STX & TRR link versus VTU source

1.2.1 Skew jitter (C1, C2),

1.2.1.1 Standard Deviation

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	9.55ps rms	8.78ps rms	9.28ps rms	-
OCP24-STX	9.13ps rms	8.92ps rms	9.96ps rms	-
LBL3- Tx	-	-	-	6.75ps rms

1.2.1.2 Peak to peak jitter

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	77ps pkpk	64ps pkpk	71ps pkpk	-
OCP24-STX	70 ps pkpk	71ps pkpk	88ps pkpk	-
LBL3- Tx	-	-	-	90ps pkpk*

* Relatively high value which can be explained by the quantity of samples considered for this measurement: 100ks instead of 30ks for the other configurations.

1.2.2 Cycle-to-cycle jitter (C2)

1.2.2.1 Standard Deviation (source reference=13.14ps rm)

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	11ps rms	10.5ps rms	12.54ps rms	-
OCP24-STX	10.97ps rms	10.63ps rms	14.6ps rms	-
LBL3- Tx	-	-	-	9.83ps rms

1.2.2.2 Peak to peak jitter (source reference=128ps pkp).

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	109 ps pkpk	90ps pkpk	104ps pkpk	-
OCP24-STX	93 ps pkpk	94ps pkpk	130 ps pkpk	-
LBL3- Tx	-	-	-	180ps pkpk

1.2.3 Period jitter over 100us

1.2.3.1 Standard Deviation (source reference=7.5ps rm)

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	6.42ps rms	6.07ps rms	7.29ps rms	-
OCP24-STX	6.47ps rms	6.15ps rms	8.50ps rms	-
LBL3- Tx	-	-	-	5.68ps rms

1.2.3.2 Peak to peak jitter (source reference=68ps pkp).

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	64ps pkpk	51ps pkpk	62ps pkpk	-
OCP24-STX	53ps pkpk	57ps pkpk	73ps pkpk	-
LBL3- Tx	-	-	-	116ps pkpk

1.2.4 Rising edge

1.2.4.1 Mean value (source reference = 935ps)

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	474ps	470ps	475ps	-
OCP24-STX	473ps	469ps	475ps	-
LBL3- Tx	-	-	-	597ps

1.2.5 Lecroy scope Jitter Noise Floor

According to Lecroy specifications for the Wavepro 7100 oscilloscope, the jitter noise floor is Gaussian, and is the following for the skew jitter, period jitter and cycle-to-cycle jitter:

Skew	4.5ps rms
Period	4.5ps rms
Cycle-to-cycle	7.5ps rms

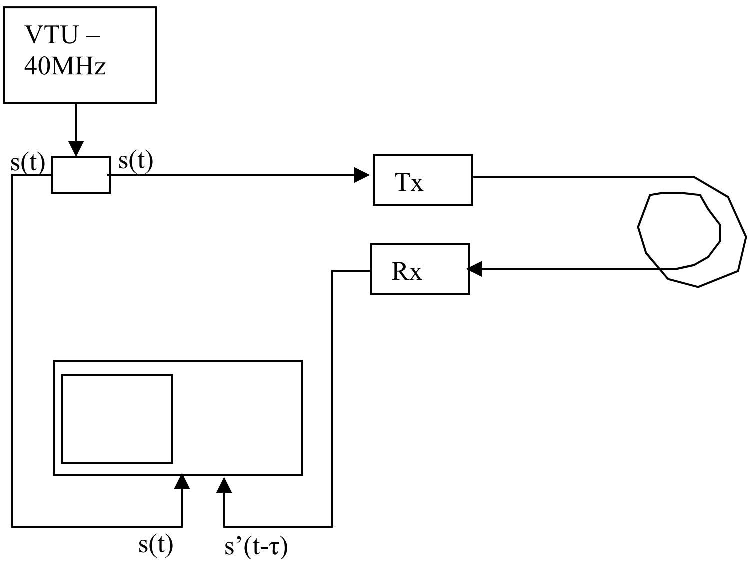
These values should be quadratically removed from the previous measurements.

For example,

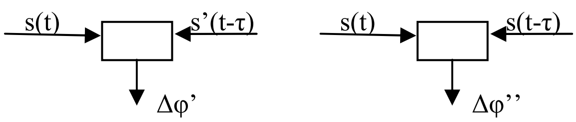
- a skew jitter of 9ps given by the scope is $realskew = \sqrt{skew^2 - 4.5^2}$ = 7.8ps rms
- a period jitter of 7ps given by the scope is $realperiod = \sqrt{period^2 - 4.5^2}$ = 5.4ps rms
- a cycle-to-cycle of 11ps given by the scope is $realcy2cy = \sqrt{cy2cy^2 - 7.5^2}$ = 8ps rms

1.2.6 Real skew jitter generated by the link

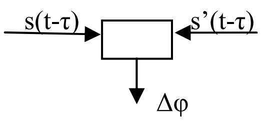
The skew jitter measured between C1 and C2 using the setup was, in fact, measured between C1(t-τ) and C2(t), if τ is the transmission time between the VTU and the scope via the TX, the 10km of fibre (approximately 50us), and the Rx. In fact, τ is of the order of 50us.



The measurements given by the scope with this setup are the 'skew jitter' $\Delta\varphi'$, and the period jitter of the source upon more than 50us, $\Delta\varphi''$:



The skew of the link only, $\Delta\varphi$, is:



$\Delta\varphi'$ results from the quadratic sum of $\Delta\varphi$ and $\Delta\varphi''$ ($\Delta\varphi'^2 = \Delta\varphi^2 + \Delta\varphi''^2$).

The resulting jitter skew of the link is thus recalculated in this table using $\Delta\varphi''$ = 7.5ps rms:

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	5.9 ps rms	4.6 ps rms	5.5 ps rms	-
OCP24-STX	5.2 ps rms	4.8 ps rms	6.6 ps rms	-
LBL3- Tx	-	-	-	0ps rms*

* $\Delta\varphi'^2 - \Delta\varphi''^2$ <0, but really close to 0.

1.3 400MHz

1.3.1 Skew jitter (C1, C2),

1.3.1.1 Standard Deviation

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	-	-	-	-
OCP24-STX	-	8.33 ps rms	-	-
LBL3- Tx	-	-	-	5.84ps rms

1.3.1.2 Peak to peak jitter

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	-	-	-	-
OCP24-STX	-	80ps pkpk	-	-
LBL3- Tx	-	-	-	76ps pkpk

1.3.2 Cycle-to-cycle jitter (C2)

1.3.2.1 Standard Deviation (source reference=8.67ps rm)

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	-	-	-	-
OCP24-STX	-	7.64ps rms	-	-
LBL3- Tx	-	-	-	8.92ps rms

1.3.2.2 Peak to peak jitter (source reference=90ps pkp).

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	-	-	-	-
OCP24-STX	-	120ps pkpk	-	-
LBL3- Tx	-	-	-	85ps pkpk

1.3.3 Period jitter over 100us

1.3.3.1 Standard Deviation (source reference=5.07ps rm)

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	-	-	-	-
OCP24-STX	-	4.41ps rms	-	-
LBL3- Tx	-	-	-	5.16ps rms

1.3.3.2 Peak to peak jitter (source reference=52ps pkp).

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	-	-	-	-
OCP24-STX	-	64ps pkpk	-	-
LBL3- Tx	-	-	-	49ps pkpk

1.3.4 Rising edge

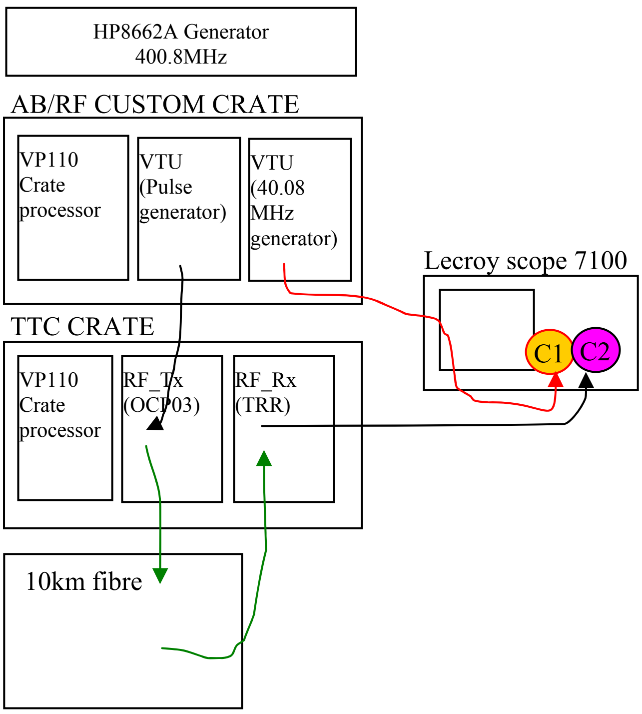
1.3.4.1 Mean value (source reference = 717ps)

TX \ RX	OCP03-SRX	OCP24-SRX	TRR	LBL3
OCP03-STX	-	-	-	-
OCP24-STX	-	427ps	-	-
LBL3- Tx	-	-	-	657ps

1.4 5NS PULSE

1.4.1 Setup

As the OCP receiver was not able to work with not-DC balanced signals, only one type of link was tested for the pulse transmission: OCP03-STX for the laser side, and TRR-1B43-000 for the receiver side.



1.4.2 Results

The results are all gathered in the following table:

	Width	Skew jitter	Rising edge	Falling Edge
Mean of the reference (VTU pulse)	5.5ns	8.5ps	905ps	661ps
Mean value	5.66ns		319ps	339ps
Standard Dev	13.9ps rms	24.9ps rms	5ps rms	5.96ps rms
pkpk	79ps pkpk	136 ps pkpk	30ps pkpk	30ps pkpk

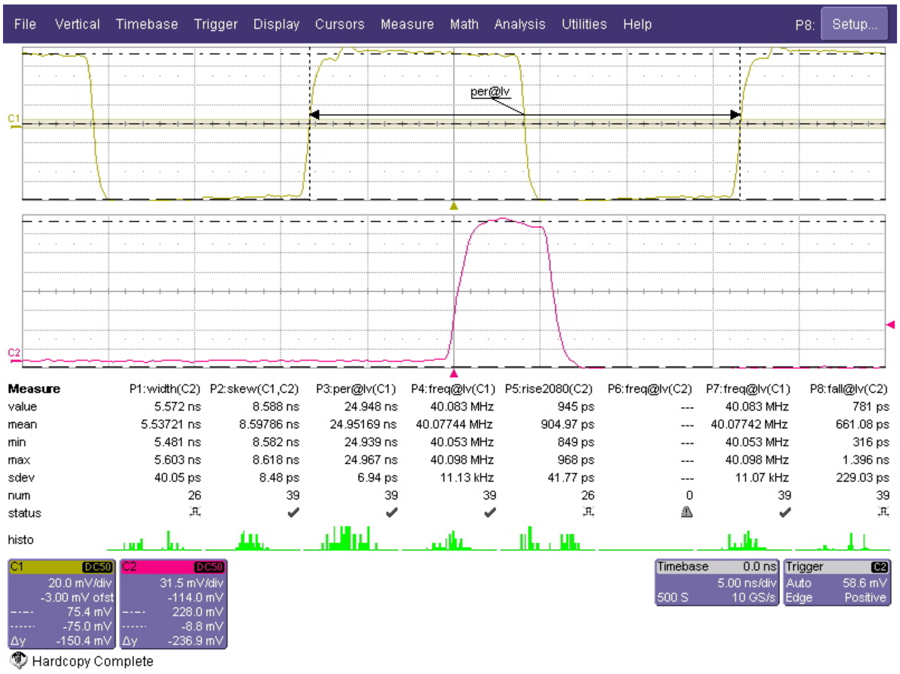


Figure 3: VTU 40.08MHz and 5ns Pulse reference

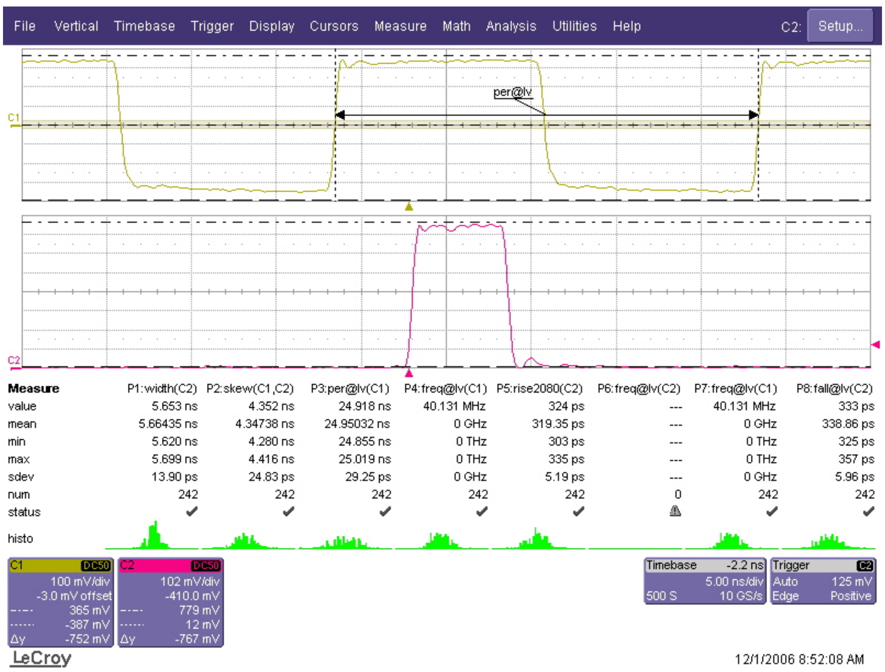


Figure 4: Transmitted Pulse versus reference clock

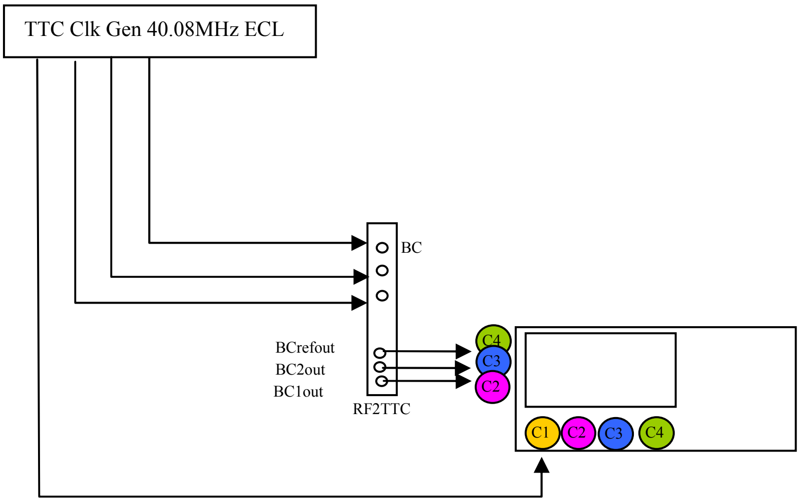
2 RF2TTC TESTS

Two types of clock generators were used to measure the jitter of the BC outputs: The TTC Clock Generator module, to deliver 4 identical copies of the same clock, or the VTU from AB/RF, with a clock source of 400MHz generated by the HP8662A. This last setup is closer to the real setup which will be used by AB/RF for the BC generation, except in term of signal amplitude.

The results obtained were sensitively different from one generator to another. Each setup is thus described with an analysis of the intrinsic jitter values of the generator itself.

2.1 40MHz Tests - TTC Clock generator

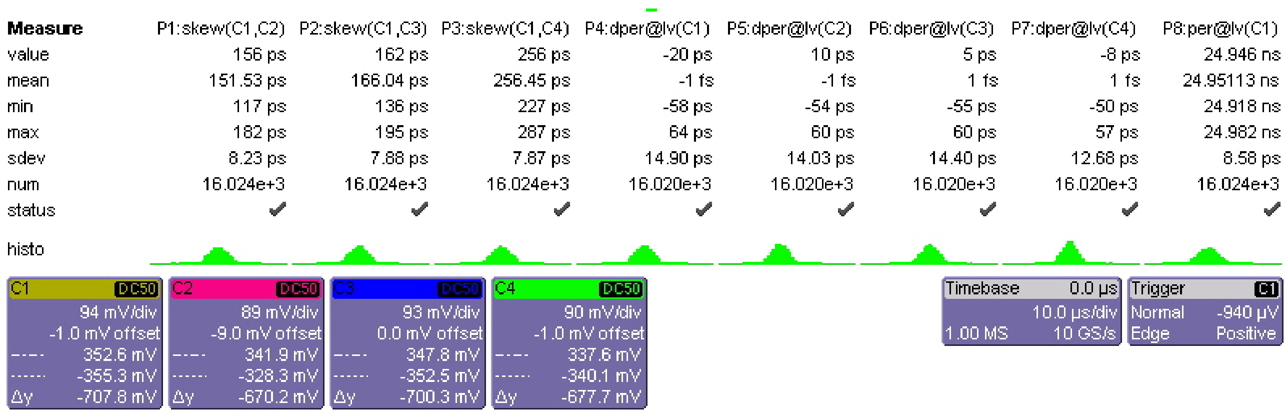
2.1.1 Setup



The 4 outputs of the TTC clock Generator used for this test were previously analysed to ensure that they do not add any extra jitter. C1, C2, C3 and C4 are all direct outputs of the TTC Clock Generator module.

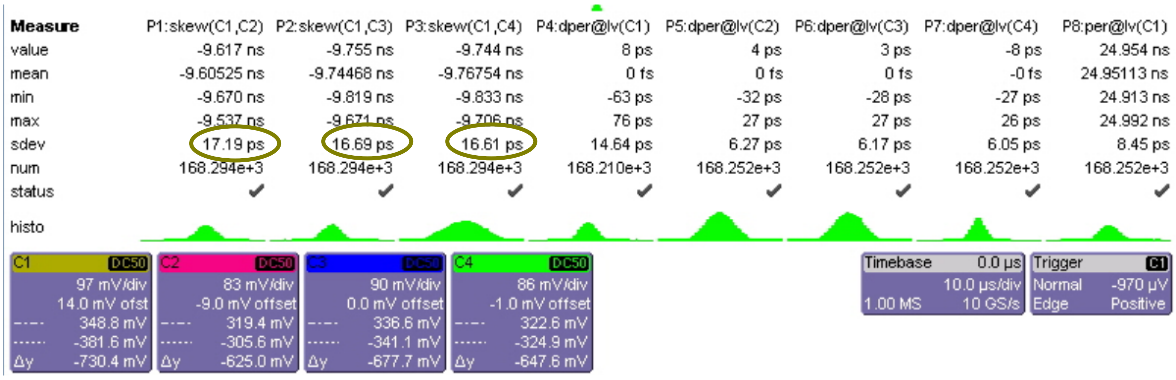
The standard deviation of the skew jitter between the 4 outputs of the generator is always around 8ps rms, and for the Cycle-to-cycle jitter, it is always of the order of 14ps rms.

The signal amplitude is about 700mV, AC-coupled.



Measure	P1:skew(C1,C2)	P2:skew(C1,C3)	P3:skew(C1,C4)	P4:dper@lv(C1)	P5:dper@lv(C2)	P6:dper@lv(C3)	P7:dper@lv(C4)	P8:per@lv(C1)
value	156 ps	162 ps	256 ps	-20 ps	10 ps	5 ps	-8 ps	24.946 ns
mean	151.53 ps	166.04 ps	256.45 ps	-1 fs	-1 fs	1 fs	1 fs	24.95113 ns
min	117 ps	136 ps	227 ps	-58 ps	-54 ps	-55 ps	-50 ps	24.918 ns
max	182 ps	195 ps	287 ps	64 ps	60 ps	60 ps	57 ps	24.982 ns
sdev	8.23 ps	7.88 ps	7.87 ps	14.90 ps	14.03 ps	14.40 ps	12.68 ps	8.58 ps
num	16.024e+3	16.024e+3	16.024e+3	16.020e+3	16.020e+3	16.020e+3	16.020e+3	16.024e+3
status	✔	✔	✔	✔	✔	✔	✔	✔
histo								

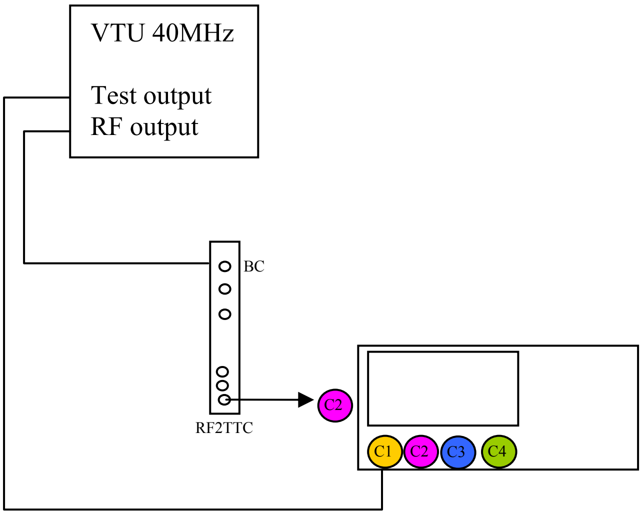
2.1.2 Results



With the TTC Clock Generator, the three outputs BC1, BC2 and BCref have similar results in term of skew compared to the first TTC clock output. It is not the case for the VTU generator (see next section).

2.2 40MHz Tests - VTU Generator

2.2.1 Setup

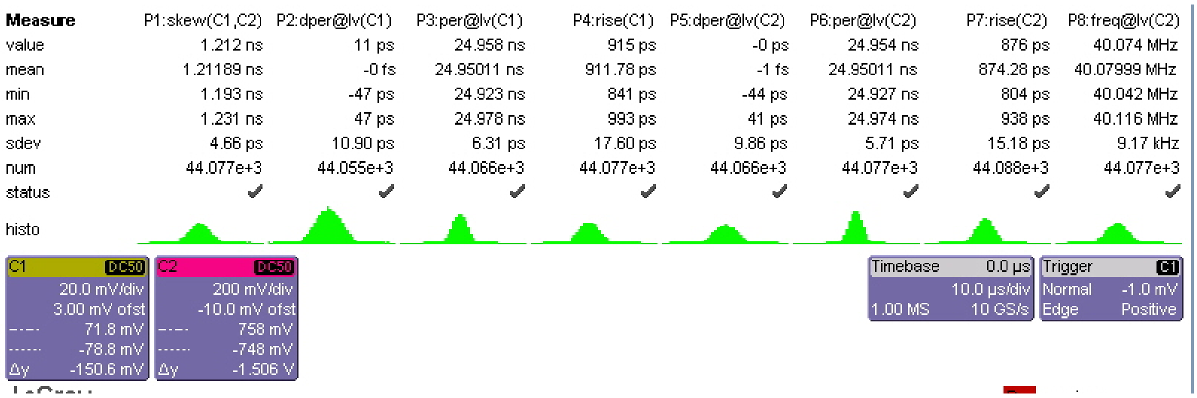


The "test output" of the VTU board is used as a reference clock for the skew measurement. Its amplitude is 150mV.

The "RF output" is the main output of the module, which can be configured with various frequencies, or as a pulse. Its amplitude is 1.6V.

The jitter between the 2 signals has been evaluated (C1 being the "test output" and C2 the "RF output"), and the results are the following:

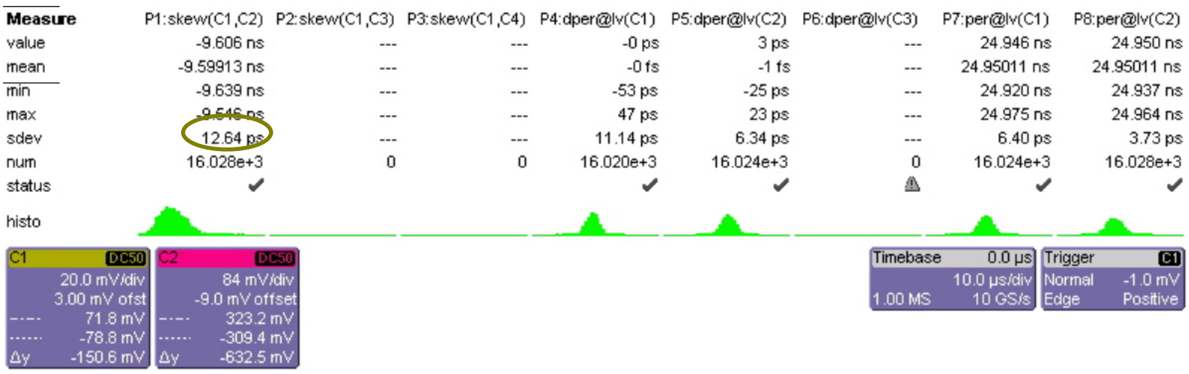
The standard deviation of the skew between the 2 outputs is about 5ps rms, the Cycle-to-cycle of each output around 10ps rms, and the period jitter is about 6ps rms.



Measure	P1:skew(C1,C2)	P2:dper@lv(C1)	P3:per@lv(C1)	P4:rise(C1)	P5:dper@lv(C2)	P6:per@lv(C2)	P7:rise(C2)	P8:freq@lv(C2)
value	1.212 ns	11 ps	24.958 ns	915 ps	-0 ps	24.954 ns	876 ps	40.074 MHz
mean	1.21189 ns	-0 fs	24.95011 ns	911.78 ps	-1 fs	24.95011 ns	874.28 ps	40.07999 MHz
min	1.193 ns	-47 ps	24.923 ns	841 ps	-44 ps	24.927 ns	804 ps	40.042 MHz
max	1.231 ns	47 ps	24.978 ns	993 ps	41 ps	24.974 ns	938 ps	40.116 MHz
sdev	4.66 ps	10.90 ps	6.31 ps	17.60 ps	9.86 ps	5.71 ps	15.18 ps	9.17 kHz
num	44.077e+3	44.055e+3	44.066e+3	44.077e+3	44.066e+3	44.077e+3	44.088e+3	44.077e+3
status	✔	✔	✔	✔	✔	✔	✔	✔
histo								

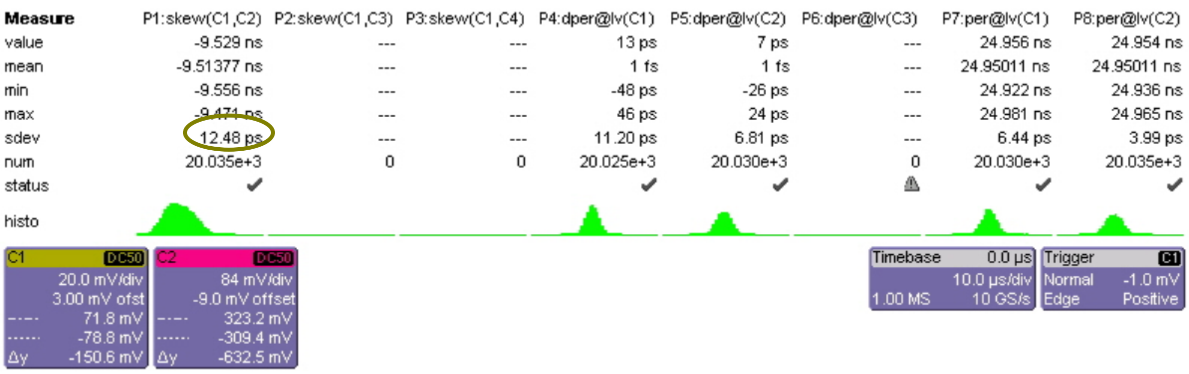
2.2.2 Results

2.2.2.1 BC1



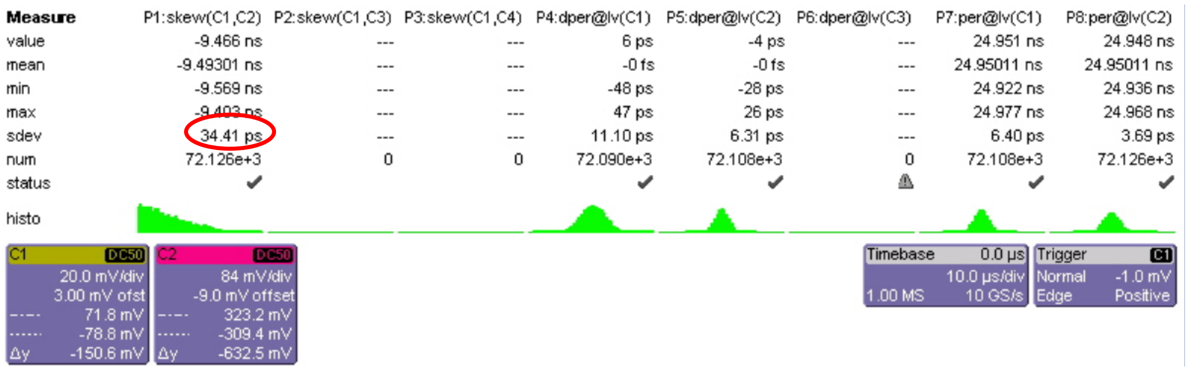
Measure	P1:skew(C1,C2)	P2:skew(C1,C3)	P3:skew(C1,C4)	P4:dper@lv(C1)	P5:dper@lv(C2)	P6:dper@lv(C3)	P7:per@lv(C1)	P8:per@lv(C2)
value	-9.606 ns	---	---	-0 ps	3 ps	---	24.946 ns	24.950 ns
mean	-9.59913 ns	---	---	-0 fs	-1 fs	---	24.95011 ns	24.95011 ns
min	-9.639 ns	---	---	-53 ps	-25 ps	---	24.920 ns	24.937 ns
max	-9.546 ns	---	---	47 ps	23 ps	---	24.975 ns	24.964 ns
sdev	12.64 ps	---	---	11.14 ps	6.34 ps	---	6.40 ps	3.73 ps
num	16.028e+3	0	0	16.020e+3	16.024e+3	0	16.024e+3	16.028e+3
status	✔			✔	✔	⚠	✔	✔
histo								

2.2.2.2 BC2



Measure	P1:skew(C1,C2)	P2:skew(C1,C3)	P3:skew(C1,C4)	P4:dper@lv(C1)	P5:dper@lv(C2)	P6:dper@lv(C3)	P7:per@lv(C1)	P8:per@lv(C2)
value	-9.529 ns	---	---	13 ps	7 ps	---	24.956 ns	24.954 ns
mean	-9.51377 ns	---	---	1 fs	1 fs	---	24.95011 ns	24.95011 ns
min	-9.556 ns	---	---	-48 ps	-26 ps	---	24.922 ns	24.936 ns
max	-9.471 ns	---	---	46 ps	24 ps	---	24.981 ns	24.965 ns
sdev	12.48 ps	---	---	11.20 ps	6.81 ps	---	6.44 ps	3.99 ps
num	20.035e+3	0	0	20.025e+3	20.030e+3	0	20.030e+3	20.035e+3
status	✔			✔	✔	⚠	✔	✔
histo								

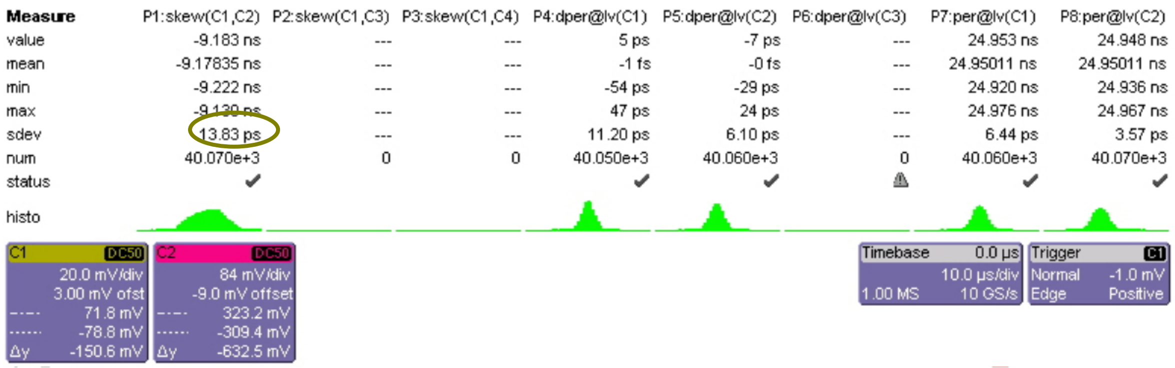
2.2.2.3 *BCref*



Measure	P1:skew(C1,C2)	P2:skew(C1,C3)	P3:skew(C1,C4)	P4:dper@lv(C1)	P5:dper@lv(C2)	P6:dper@lv(C3)	P7:per@lv(C1)	P8:per@lv(C2)
value	-9.466 ns	---	---	6 ps	-4 ps	---	24.951 ns	24.948 ns
mean	-9.49301 ns	---	---	-0 fs	-0 fs	---	24.95011 ns	24.95011 ns
min	-9.569 ns	---	---	-48 ps	-28 ps	---	24.922 ns	24.936 ns
max	-9.403 ns	---	---	47 ps	26 ps	---	24.977 ns	24.968 ns
sdev	34.41 ps	---	---	11.10 ps	6.31 ps	---	6.40 ps	3.69 ps
num	72.126e+3	0	0	72.090e+3	72.108e+3	0	72.108e+3	72.126e+3
status	✔			✔	✔	⚠	✔	✔

2.2.2.4 *BCmain as BC1*

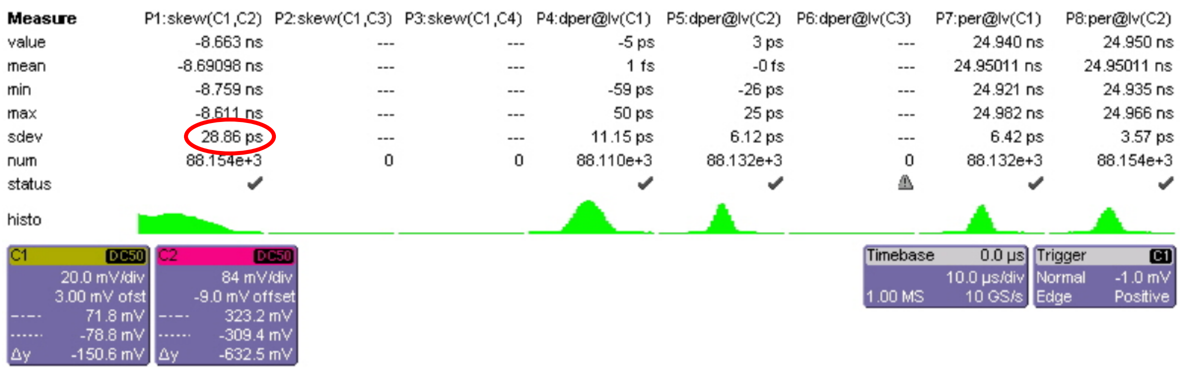
For this measurement, BCmain is configured to be the same as the BC1 output.



Measure	P1:skew(C1,C2)	P2:skew(C1,C3)	P3:skew(C1,C4)	P4:dper@lv(C1)	P5:dper@lv(C2)	P6:dper@lv(C3)	P7:per@lv(C1)	P8:per@lv(C2)
value	-9.183 ns	---	---	5 ps	-7 ps	---	24.953 ns	24.948 ns
mean	-9.17835 ns	---	---	-1 fs	-0 fs	---	24.95011 ns	24.95011 ns
min	-9.222 ns	---	---	-54 ps	-29 ps	---	24.920 ns	24.936 ns
max	-9.130 ns	---	---	47 ps	24 ps	---	24.976 ns	24.967 ns
sdev	13.83 ps	---	---	11.20 ps	6.10 ps	---	6.44 ps	3.57 ps
num	40.070e+3	0	0	40.050e+3	40.060e+3	0	40.060e+3	40.070e+3
status	✔			✔	✔	⚠	✔	✔

2.2.2.5 *BCmain as BCref*

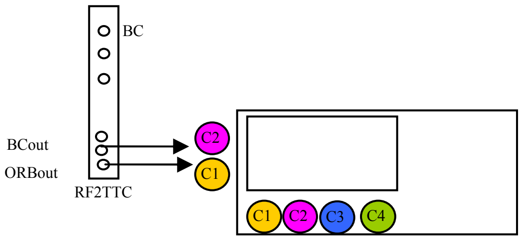
For this measurement, BCmain is configured to be the same as the BCref output.



Measure	P1:skew(C1,C2)	P2:skew(C1,C3)	P3:skew(C1,C4)	P4:dper@lv(C1)	P5:dper@lv(C2)	P6:dper@lv(C3)	P7:per@lv(C1)	P8:per@lv(C2)
value	-8.663 ns	---	---	-5 ps	3 ps	---	24.940 ns	24.950 ns
mean	-8.69098 ns	---	---	1 fs	-0 fs	---	24.95011 ns	24.95011 ns
min	-8.759 ns	---	---	-59 ps	-26 ps	---	24.921 ns	24.935 ns
max	-8.611 ns	---	---	50 ps	25 ps	---	24.982 ns	24.966 ns
sdev	28.86 ps	---	---	11.15 ps	6.12 ps	---	6.42 ps	3.57 ps
num	88.154e+3	0	0	88.110e+3	88.132e+3	0	88.132e+3	88.154e+3
status	✔			✔	✔	⚠	✔	✔

2.3 ORBIT TESTS

2.3.1 Setup



The orbits tested here were internally generated. External orbits are treated in the section "system tests", because the use of 2 VTU modules were necessary to get the 5ns external pulse synchronised to the 40.08MHz Bunch Clock.

Two sizes of orbit outputs are treated here: 75ns (3 BC long), or 1us (40 BC long).

One point needs to be looked at for the output of the negative orbit: the amplitude of the signal is reduced to less than 600mV, whereas the positive orbit is more than 700mV high.

2.3.2 Positive Orbit

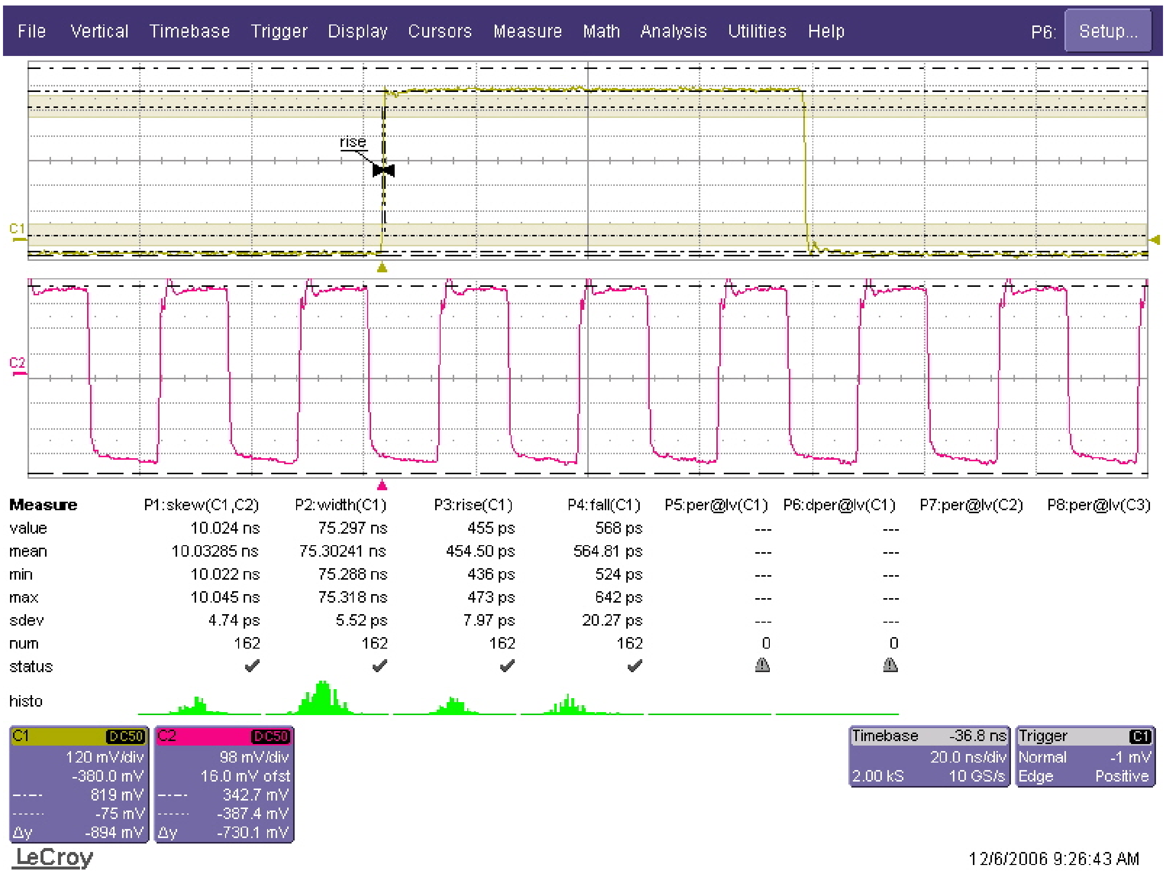


Figure 5: 3BC long positive orbit

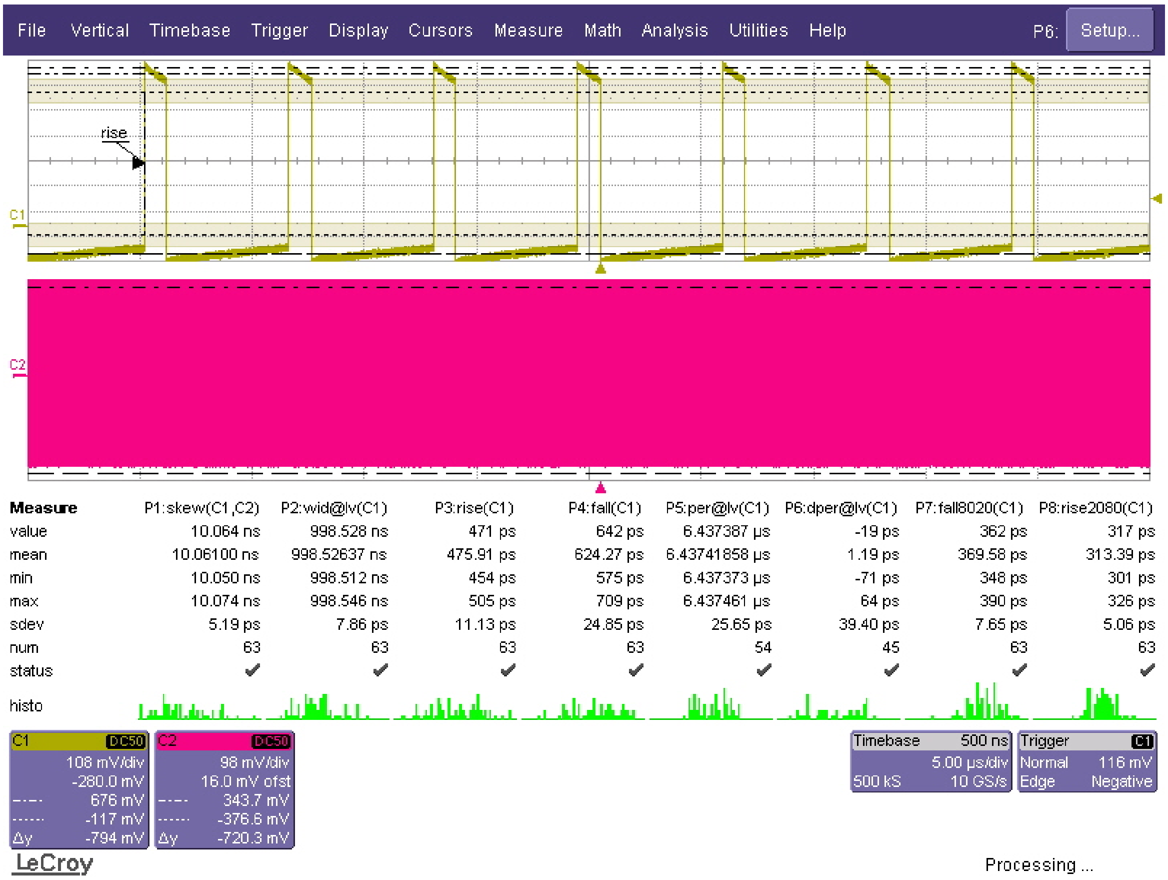


Figure 6: 40 BC long positive orbit

2.3.3 Negative Orbit

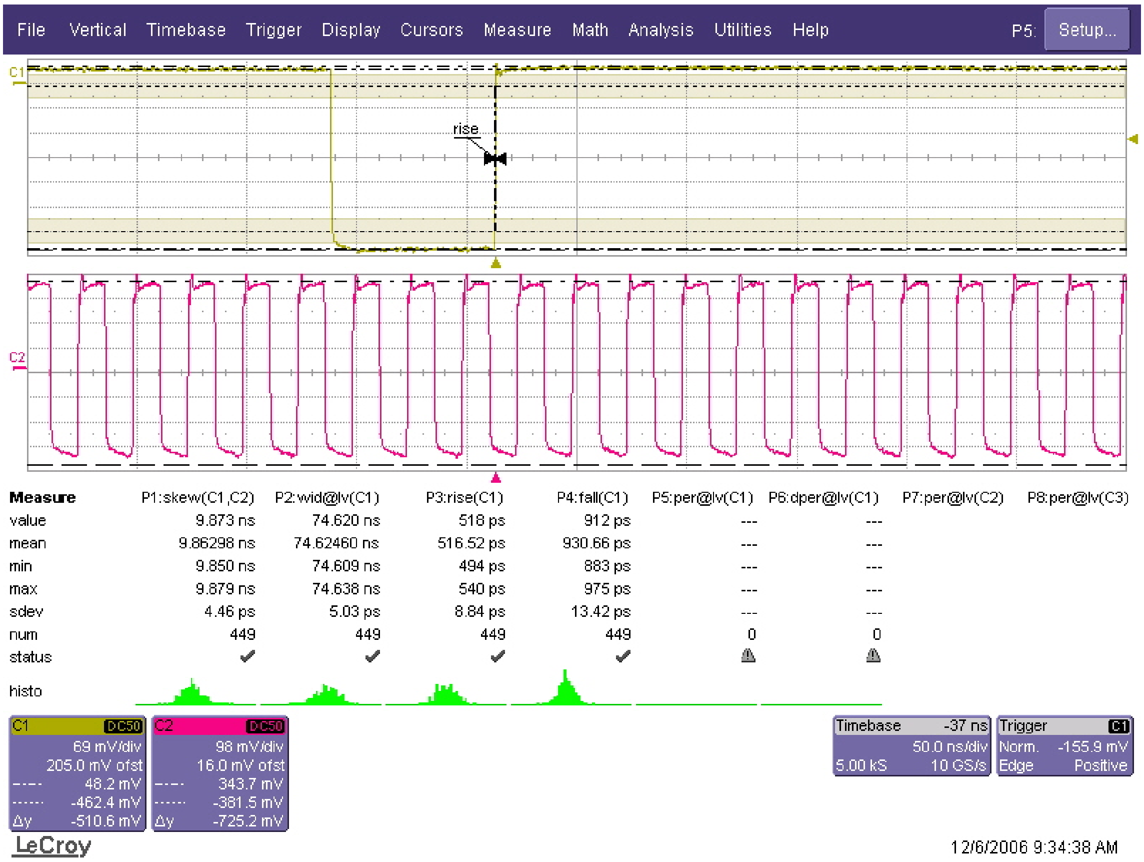


Figure 7: 3 BC long negative orbit

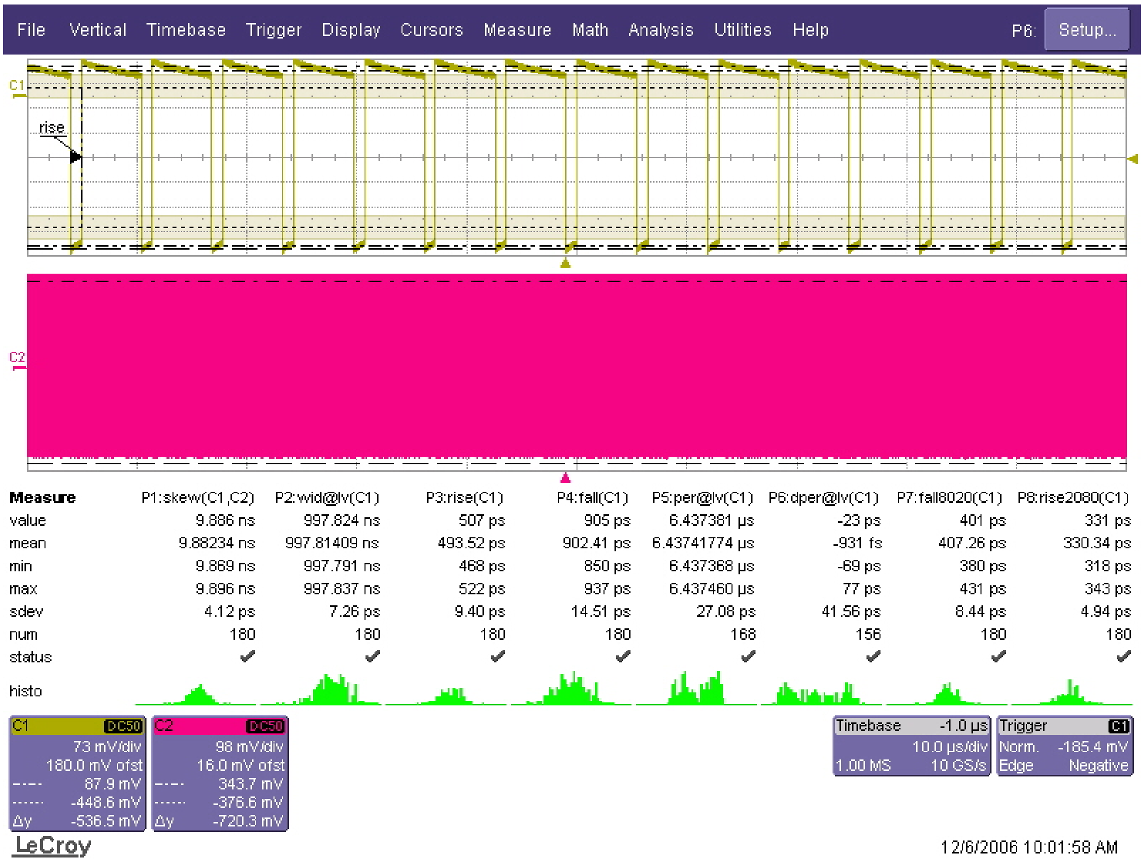
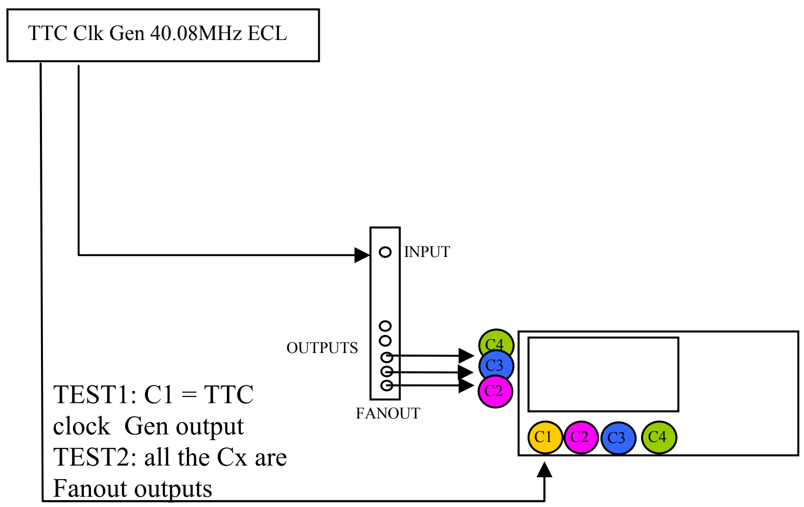


Figure 8: 40 BC long negative orbit

3 FANOUT TEST

3.1 40MHZ TRANSMISSION

3.1.1 Setup



3.1.2 Results

3.1.2.1 Test1

Measure	P1:skew(C1,C2)	P2:skew(C1,C3)	P3:dper@lv(C1)	P4:dper@lv(C2)	P5:dper@lv(C3)	P6:per@lv(C1)	P7:per@lv(C2)	P8:per@lv(C3)
value	6.276 ns	6.206 ns	-32 ps	3 ps	-6 ps	24.931 ns	24.953 ns	24.948 ns
mean	6.26450 ns	6.20140 ns	-1 fs	0 fs	0 fs	24.95112 ns	24.95112 ns	24.95112 ns
min	6.234 ns	6.173 ns	-64 ps	-28 ps	-32 ps	24.918 ns	24.934 ns	24.933 ns
max	6.297 ns	6.235 ns	61 ps	29 ps	30 ps	24.985 ns	24.970 ns	24.969 ns
sdev	7.42 ps	7.39 ps	15.39 ps	7.19 ps	7.61 ps	9.03 ps	4.30 ps	4.48 ps
num	36.063e+3	36.063e+3	36.045e+3	36.054e+3	36.054e+3	36.054e+3	36.063e+3	36.063e+3
status	✔	✔	✔	✔	✔	✔	✔	✔
histo								

C1 DC50	C2 DC50	C3 DC50	Timebase 0.0 µs	Trigger C1
97 mV/div	116 mV/div	120 mV/div	10.0 µs/div	Normal -970 µV
14.0 mV ofst	-10.0 mV ofst	0.0 mV offset	1.00 MS 10 GS/s	Edge Positive
348.8 mV	444 mV	449 mV		
-381.6 mV	-430 mV	-455 mV		
Δy -730.4 mV	Δy -873 mV	Δy -904 mV		

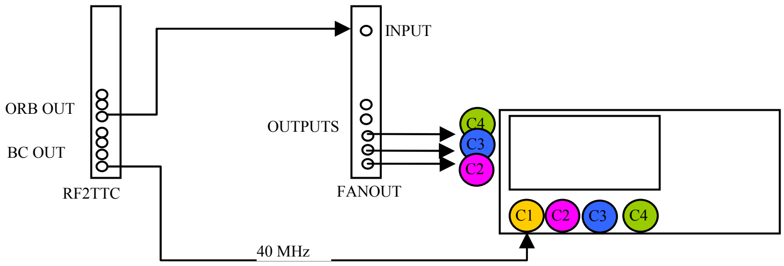
3.1.2.2 Test2

Measure	P1:skew(C1,C2)	P2:skew(C2,C3)	P3:skew(C1,C3)	P4:skew(C1,C4)	P5:skew(C3,C4)	P6:skew(C2,C4)	P7:per@lv(C2)	P8:per@lv(C3)
value	45 ps	-40 ps	1 ps	50 ps	50 ps	9 ps		
mean	44.20 ps	-41.99 ps	3.38 ps	52.03 ps	48.34 ps	11.04 ps		
min	30 ps	-60 ps	-12 ps	37 ps	31 ps	-7 ps		
max	59 ps	-26 ps	18 ps	67 ps	65 ps	29 ps		
sdev	3.50 ps	4.06 ps	3.60 ps	3.67 ps	4.16 ps	4.12 ps		
num	56.084e+3	56.084e+3	56.084e+3	56.084e+3	56.084e+3	56.084e+3		
status	✔	✔	✔	✔	✔	✔		
histo								

C1 DC50	C2 DC50	C3 DC50	C4 DC50	Timebase 0.0 µs	Trigger C1
97 mV/div	116 mV/div	120 mV/div	116 mV/div	10.0 µs/div	Normal -970 µV
14.0 mV ofst	-10.0 mV ofst	0.0 mV offset	0.0 mV offset	1.00 MS 10 GS/s	Edge Positive
348.8 mV	444 mV	449 mV	434 mV		
-381.6 mV	-430 mV	-455 mV	-440 mV		
Δy -730.4 mV	Δy -873 mV	Δy -904 mV	Δy -873 mV		

3.2 Pulse Transmission

3.2.1 Setup



3.2.2 Results

3.2.2.1 Positive orbit

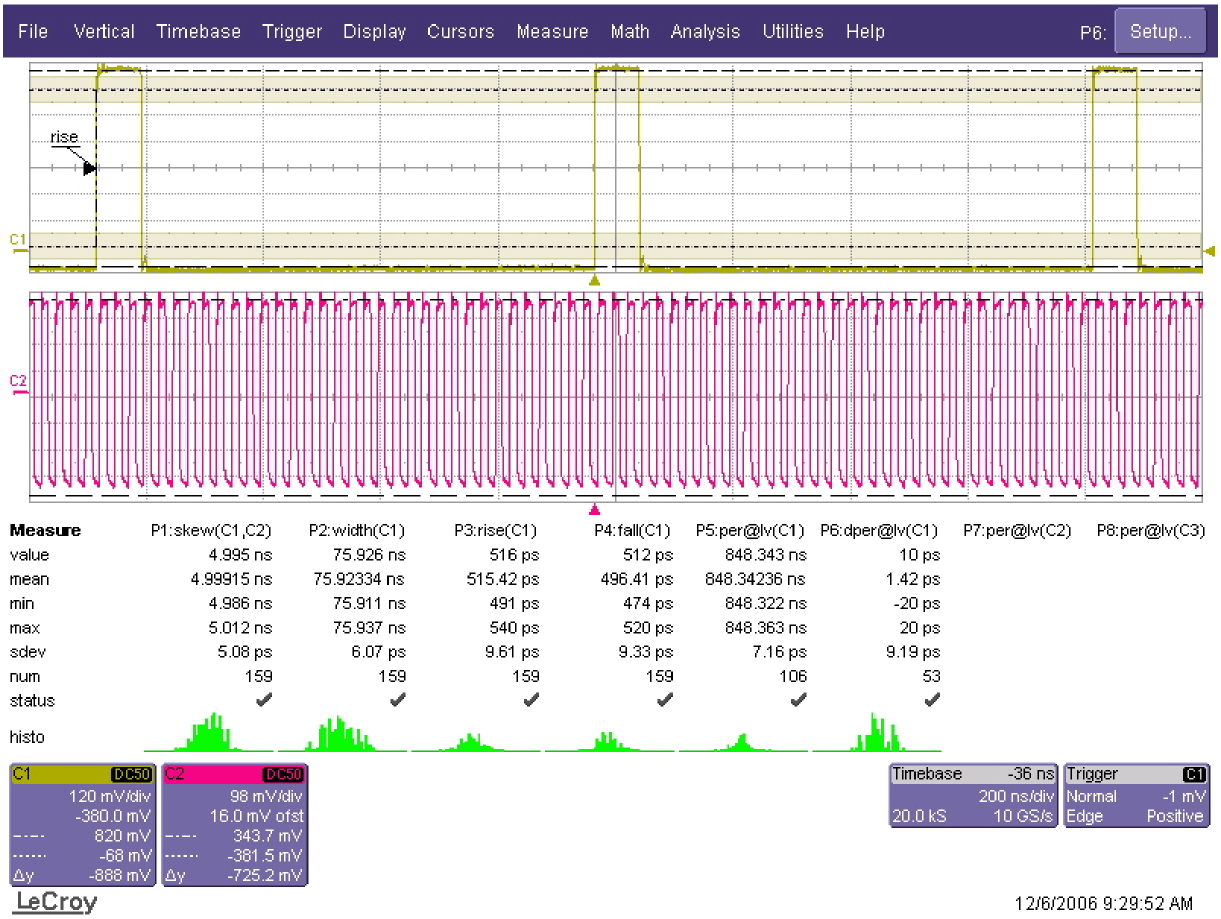


Figure 9: 3BC long positive orbit via fanout

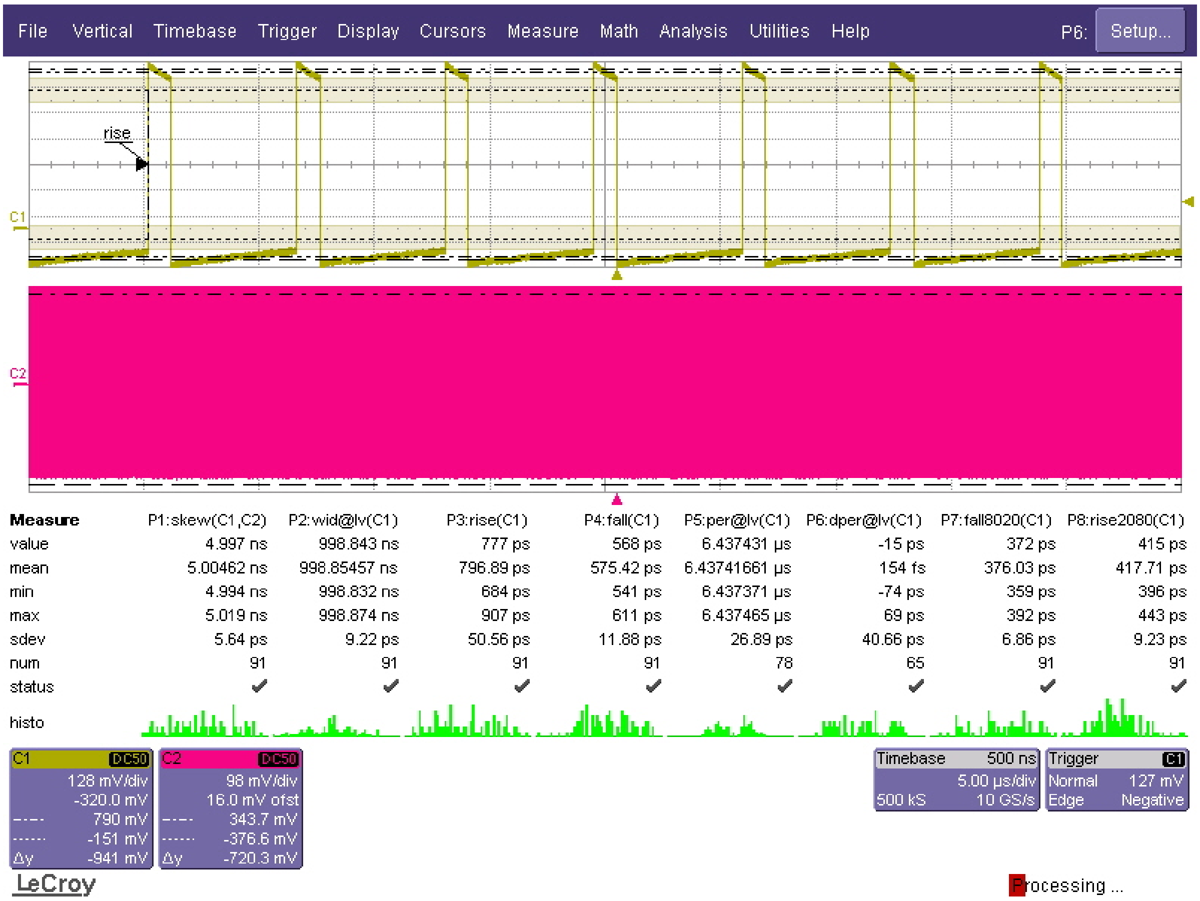


Figure 10: 40 BC long positive orbit via fanout

3.2.2.2 *Negative orbit*

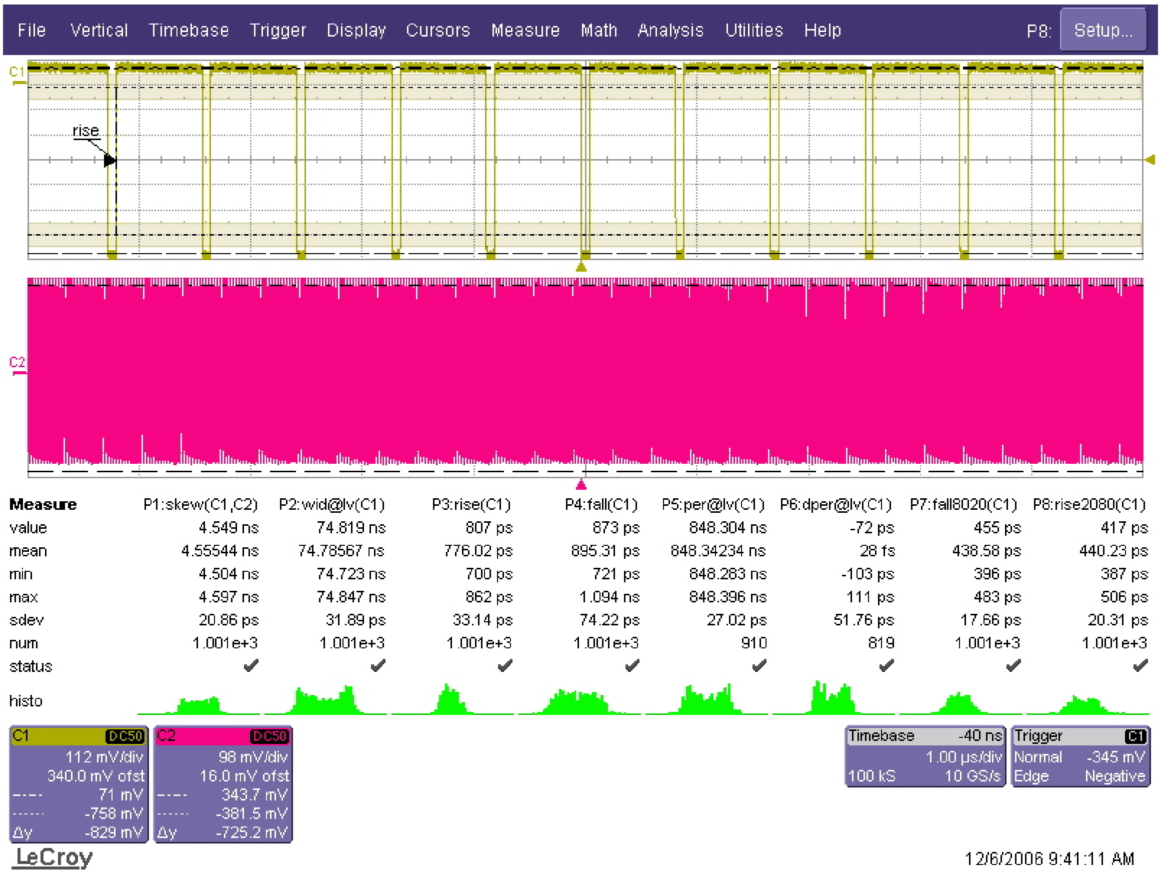


Figure 11: 3BC long negative orbit via fanout

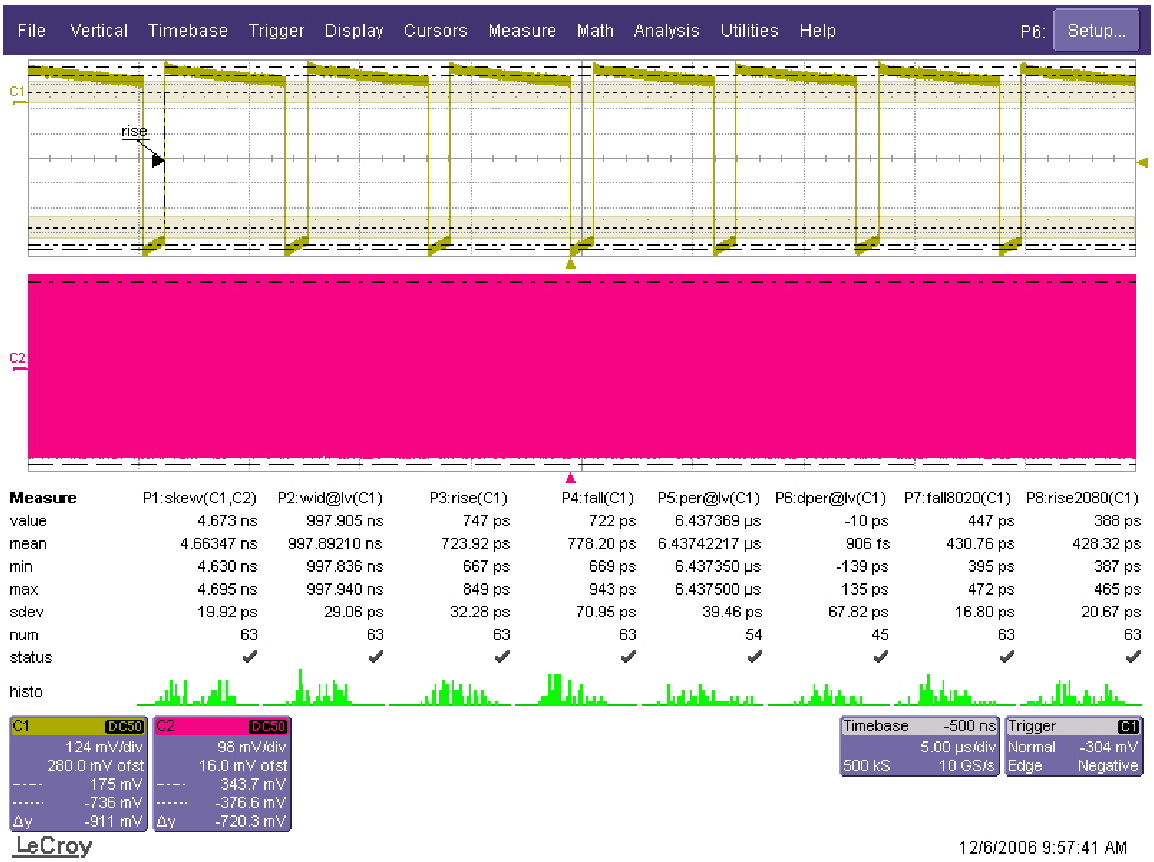


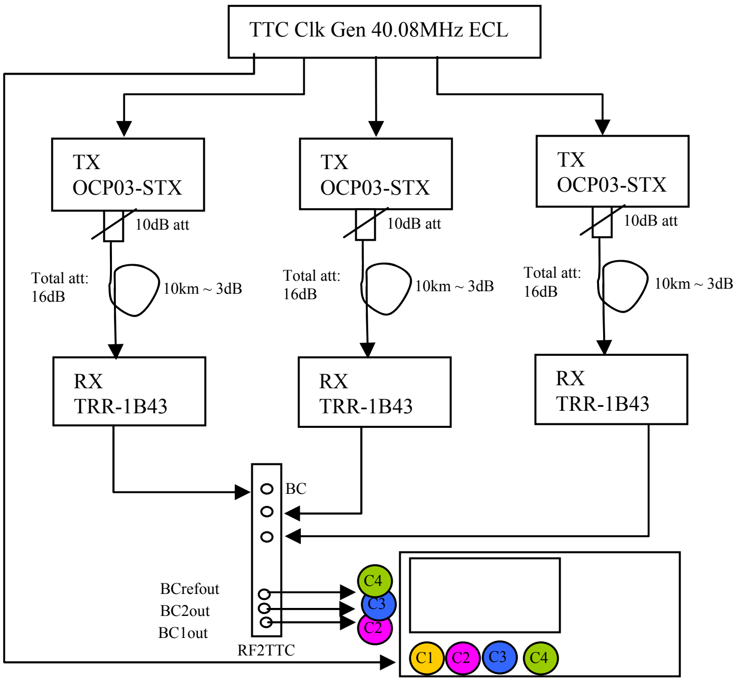
Figure 12: 40 BC long negative orbit via fanout

4 SYSTEM TEST

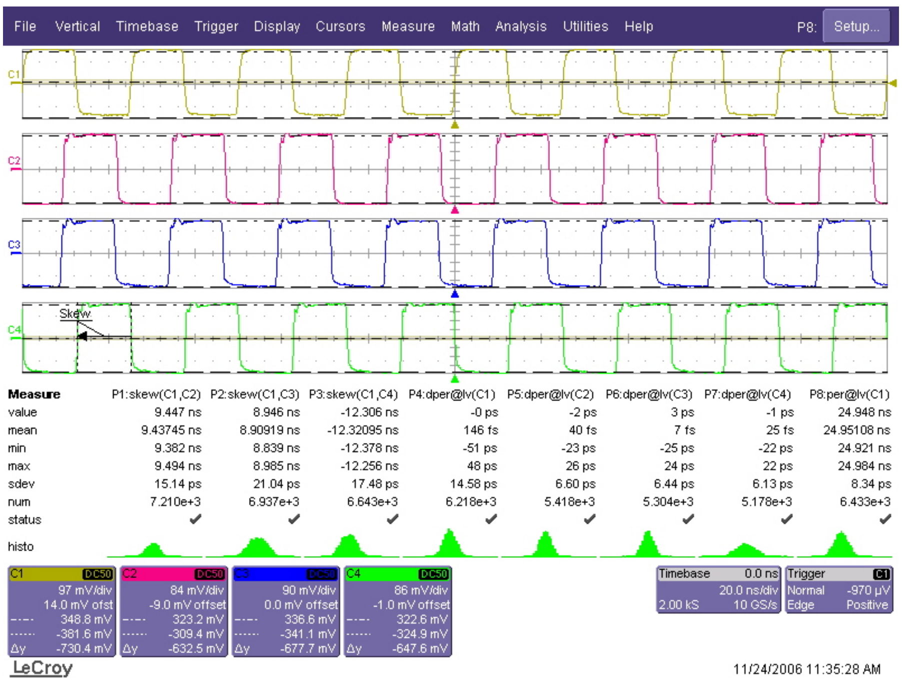
4.1 40MHZ TRANSMISSION TESTS

4.1.1 Concurrent 40MHz transmission

4.1.1.1 Setup



4.1.1.2 Results



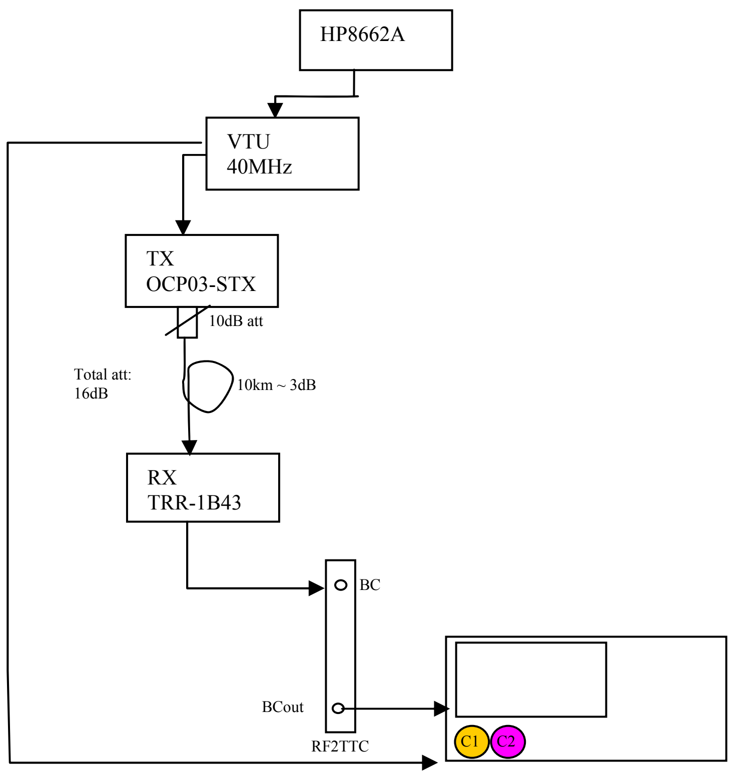
	Skew jitter vs C1	Cycle-to-Cycle jitter
TTC Clock Gen (C1)	-	14.6 ps rms
BC1 (C2)	15.1ps rms	6.6 ps rms
BC2 (C3)	21 ps rms	6.4 ps rms
BCref (C4)	17.5 ps rms	6.1 ps rms

An analysis of many parameters on the BC1 output of the RF2TTC was done, giving:

	Cy2Cy	Frequency	Period	Duty Cycle	TIE	Ampl
Mean value		40.078MHz	24.95ns	49.9%	-1.3ps	733mV
Standard Dev	6.70 ps rms	6.24kHz rms	3.89ps rms	0.012%	4.0ps rms	1.62mV rms
pkpk	61ps pkpk	55kHz pkpk	34ps pkpk	0.11% pkpk	34ps pkpk	8mV pkpk

4.1.2 Individual Clock transmission

4.1.2.1 Setup



4.1.2.2 *Results*

- BC1

	Skew versus ref	Cy2Cy	Frequency	Period	Duty Cycle
Ref Std Dev		11ps rms	10.27kHz rms	6.40ps rms	
Mean value			40.0799MHz	24.95ns	49.9%
Standard Dev	16.6ps rms	6.25ps rms	5.87kHz rms	3.65ps rms	0.014%
pkpk	110ps pkpk	42ps pkpk	50kHz pkpk	34ps pkpk	0.11% pkpk

- BC2

	Skew versus ref	Cy2Cy	Frequency	Period	Duty Cycle
Ref Std Dev		11ps rms	10.27kHz rms	6.40ps rms	
Mean value			40.0799MHz	24.95ns	49.8%
Standard Dev	21.7ps rms	6.07ps rms	5.65kHz rms	3.51ps rms	0.013%
pkpk	120ps pkpk	62ps pkpk	50kHz pkpk	32ps pkpk	0.11% pkpk

- BCref

	Skew versus ref	Cy2Cy	Frequency	Period	Duty Cycle
Ref Std Dev		11ps rms	10.27kHz rms	6.40ps rms	
Mean value			40.0799MHz	24.95ns	49.9%
Standard Dev	36ps rms	6.28ps rms	5.88kHz rms	3.66ps rms	0.012%
pkpk	154ps pkpk	57ps pkpk	50kHz pkpk	33ps pkpk	0.12% pkpk

- BCmain on BC1

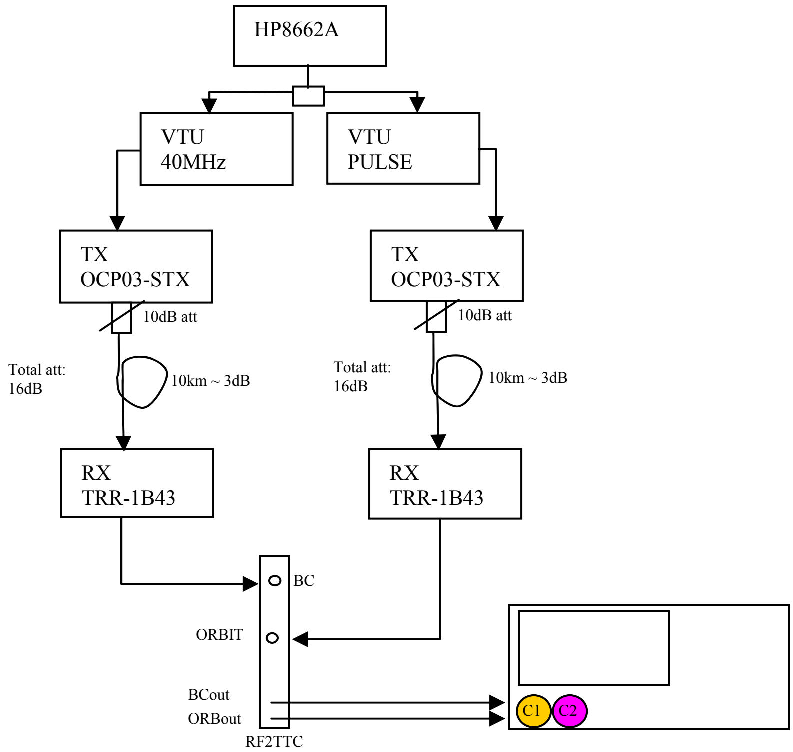
	Skew versus ref	Cy2Cy	Frequency	Period	Duty Cycle
Ref Std Dev		11ps rms	10.27kHz rms	6.40ps rms	
Mean value			40.0799MHz	24.95ns	49.8%
Standard Dev	17.9ps rms	5.99ps rms	5.61kHz rms	3.49ps rms	0.013%
pkpk	104ps pkpk	50ps pkpk	50kHz pkpk	32ps pkpk	0.11% pkpk

- BCmain on BCref

	Skew versus ref	Cy2Cy	Frequency	Period	Duty Cycle
Ref Std Dev		11ps rms	10.27kHz rms	6.40ps rms	
Mean value			40.0799MHz	24.95ns	49.8%
Standard Dev	40.7ps rms	6.23ps rms	5.83kHz rms	3.63ps rms	0.012%
pkpk	198ps pkpk	50ps pkpk	49kHz pkpk	33ps pkpk	0.10% pkpk

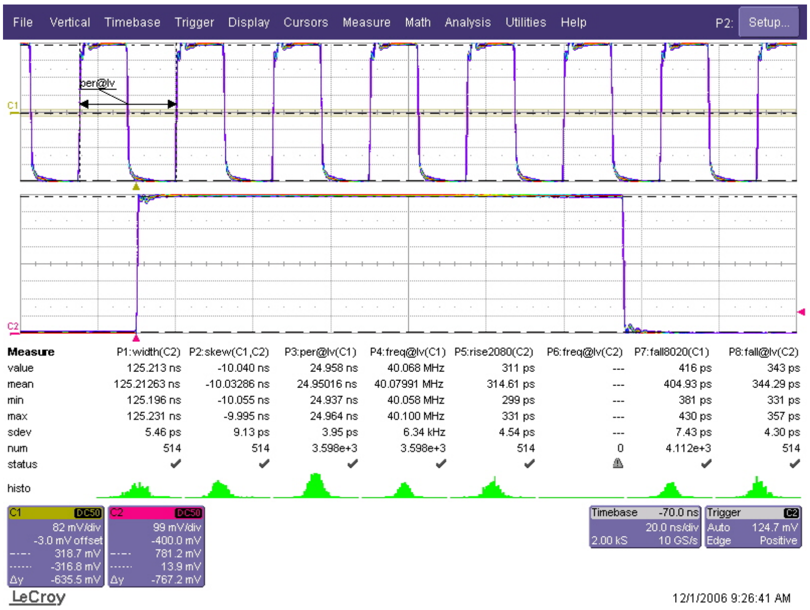
4.2 40MHz and Pulse Transmission Tests

4.2.1 Setup



4.2.2 Results

Here, the orbit output was configured to be a positive pulse of 5 BC long.



The results are gathered in the following table:

	Output Pulse width	Skew of the Orbit_out versus BCout	Orbit rising edge	Orbit falling edge
Mean	125.2ns		312ps	405ps
Standard Deviation	5.43ps rms	9ps rms	4.73ps rms	7.45ps rms
Pkpk	30ps pkpk	60ps rms	50ps pkpk	42ps pkpk