**10-20 GS/s Sampling chip V4**

**-1 Specifications.**

Channels 4 + 1 test + 1 timing

Sampling rate 10-20 GS/s

Analog Bandwidth 1-2GHz

Self or External trigger

Dynamic range 800mV

Sampling window 400ps-800ps (or 8 delay cells)

Sampling jitter 10ps

Crosstalk 1%

DLL Timing generator Internal phase comparator and charge pump, external LP filter

DC Input impedance ½ 50 internal, ½ external

Conversion clock Adjustable 500MHz 1GHz internal ring oscillator.

Maximum conversion time 8us.

Read clock 40 MHz. Readout time (4-channel) 4 x 256 x 25ns=25.6 s

Power 40mW/channel

Power supply 1.2V

Process IBM 8RF-DM (130nm CMOS)

**-2 I/Os**

**Signal Name Type I/O Pad Function**

**SCA Channels Inputs**

signal0-4 aI Analog inputs 0-1V, 50 to returns vbias0-4

vbiasl0-4 aI Input return

thresh0-4 aI External Channel Triggers thresholds

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**Channel common digital signals**

COMPbypass\_sel dI Selects the latch of the ADC counters. Low: Latch\_EXT, High: sampling cell

comparator’s output.

Latch\_EXT dI External Latch of the ADC counters (regular is sampling cells comparator’s

outputs)

READswitch\_cntrl dI Read switch control. Enables the sampling cell voltage onto the

 sampling cell comparator.

TRIGsign dI Threshold on negative or positive input transition.

TRIGen dI Selects internal or external trigger

TRIG dI High: freezes the voltage on the sampling caps. Low: the fixed sampling

 window (8 delay cells) on channels 0 and 1, the variable sampling window on

 channels 2-4 to controls the sampling cells

RO\_en dI Enables the RO frequency divider (1:4) to clock the ADC.

RAMP dI Enables the ramp (active low). Clears Cext when high.

ClearADC dI Resets the ADC counters.

ClearTRIG dI Clears the internal triggers responses.

RESET\_DLL dI Resets the DLL’s timing generator control voltages

RO\_freq\_sel dI Selects the ADC clock frequency (divide 1 or 4)

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**Analog Voltages/currents**

TRIGbias aI Bias current for the input comparators (triggers).

CEXT aI External capacitor (RAMP)

RAMPbias aI Controls the ramp current (slope).

V2GN aI Controls the ADC ring oscillator frequency clock falling edge

V2GP aI “ “ leading edge

VswN aI Controls the sampling window falling edge

VswP aI “ leading edge

biasDLL\_1 aI Controls the charge pump “ups”

biasDLL\_2 aI “ “downs”

Ipol1 aI Controls Charge pump for DLL falling edge

Ipol2 aI “ “ rising edge

COMPin\_test+ aI Test comparator input +

COMPin\_test- aI “ -

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**Clocks/Readout**

WriteCLK dI Write clock (40 MHz to timing generator)

Copy\_CLKin dI Copy of Write clock

Rd\_ck-1-2 dI Read clocks (40 MHz)

Tok\_in-1-2 dI Inputs of the token passing

CHIP\_oe dI Chip output enable (12 data bus). Active low.

D0-11 dO 12-bit data bus controlled by the tokens (see below) and the

Channel decoder outputs.Tied to ground in the Hi-Z state with a large internal resistor.

Overflow dO ADC’s counters overflo

tokout-1-2 dO Output of the token passing

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**Test outputs**

ROmonitor dO Bit #9 of the ADC counter (divide frequency by 1024)

SerialDAT\_test dO Serial test data output (ADC’s counter + overflow) available

 on token 2 65-77

COMPtest dO Test comparator output

ROfan\_test dO Test counter 9th bit buffered output

RAMP\_buffer\_out aO Ramp test output

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**Trigger outputs**

TRIGout\_0-4 dO Channel Triggers inputs.

Trigger\_or\_out dO OR of the Channel Triggers outputs

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**DLL outputs**

VDL\_out dO Output from VCDL for delay lock

VCN\_out aO Rising edge analog output control

VCP\_out aO Falling edge analog output control

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**Channel and Token controls address Decoders**

ChanX-Y-Z dI Channel address, selects the channel to be read.

 0 no channel selected

 1-5 channel 1-5

 6 clear the ring oscillator monitor counter

 7 xx (or channel 6 if implemented)

TokX-Y-Z dI Token control. Readout as 4 blocks of 64/channel (to skip

 known off-time data)

 0 no block selected,

1-4 token block 1-4

5 clear token

 6 clear trig

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**Power supplies**

Vdd +1.2V

Gnd 0V

Chip:

81 I/Os

22 Gnd

16 Vdd

119 pads (one unused)

Package CQFP120B:

120 pads

All analog inputs protected with DC path to Gnd and Vdd +/- .6V (5 x 10 m2 diodes).

**-3 Operation Modes**

**Modes**

Write Writes continuously samples of inputs in 60 fF sampling caps arrays at 10-20 GS/s for 25=12.5 ns. Sampling stopped upon internal or external trigger.

 Conversion Clears 2 GHz counter, ramps up Wilkinson ADCs for 2 s.

Read Sequences 256 counters of the channel selected by Chan-0-3 onto the data bus

at 40 MHz read clock rate. Readout can be partitioned into four blocks of 64 caps (token readout) for each channel. Token controlled by three bits (see above)

 **Test structures**

Test structure including a full 12-bit ADC. Outputs read sequentially using the token 2 control.

**-4 Layout (to be updated)**

Blocks sizes: Timing generator 10 x 12 m2 x 256

 Sampling cell 12 x 100 “

 Input comparator 30 x 25 x 4

 Comparator 12 x 30 x 256

 Counter 12 x 300 “

 Token 12 x 40 “

 Ramp 100 x 300

 Ramp buffer 260 x 65

 Ring Oscillator 12 x 50

 Divider 12 x 300



Size: 4500 x 4500 m2