

# **SKAMP Continuum Correlator**

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## Introduction

The SKA Molonglo Prototype (SKAMP) is a three stage upgrade to the Molonglo telescope that will demonstrate significant cylindrical reflector technologies for the SKA. The first stage is nearing completion and will provide a 96 input continuum correlator for the current 3MHz IFs. This will eventually replace the current correlator providing images with higher dynamic range and extra inputs for interference mitigation. With the addition of extra memory this design is upgraded to a spectral line correlator with a bandwidth of 7.3MHz.

## System operation

The correlator consists of two major subsystems these being: •The data reordering system

•The cross multiply accumulate (XMAC) array

The top and side data reordering units utilise the channel reordering principle to feed data to the XMAC array in antenna groups, thus minimising the data bandwidth to the long term accumulation memory.

The XMAC array operates continuously at 133MHz allowing each XMAC to process 18 baselines.

# Data Reordering

The data reorders each accept 96 7.33MHz inputs, time multiplexed onto 12 parallel data paths. This data is double buffered in sample groups of 64. At the output the data is divided into 6 groups (a-f) of 16 signals. These are processed in 18 cycles with the input to the top and side of the XMAC array as shown in the table opposite. Over the 18 successive cycles, all 4560 cross correlation are formed.

#### Hardware

The correlator is built on a 350mm x 250mm PCB containing 8 layers. There are 21 FPGA's used in the correlator, all being XILINX Spartan IIE 300,000 gate Ball Grid Arrays (XC2S300E-6FG456). The chosen signalling standard entering and leaving the board is LVDS to ensure signal integrity and minimise noise. Data is passed to a logging computer via a PCI interface.



Group Processing Scheme				
Cycle			Mode	
1	а	b	cross	
2	а	С	cross	
3	а	d	cross	
4	а	е	cross	
5	а	f	cross	
6	b	С	cross	
7	b	d	cross	
8	b	е	cross	
9	b	f	cross	
10	С	d	cross	
11	С	е	cross	
12	С	f	cross	
13	d	е	cross	
14	d	f	cross	
15	е	f	cross	
16	а	b	self	
17	С	d	self	
18	е	f	self	

#### The SKAMP Continuum Correlator





# **Cross multiply array**

The cross multiply array is made up of 16 FPGAs in a 4X4 array. Each FPGA contains 16 complex XMAC units, again arranged in a 4X4 array. Internally these are further divided into 2x2 blocks with latches to buffer the data (shown above) allowing the FPGAS to obtain the 133MHz clock rate required. The array operate in two modes:

1.Cross mode, where top and side data is correlated.

2.Self mode, where correlations internal to the data groups are formed. In Self mode the four diagonal FPGAs are configured as shown above.

Each XMAC is double buffered and accumulates sets of 64 correlation for each baseline. While one baseline is being processed the previous sum is added to long term memory, which is currently implemented using FPGA RAM.