SAS Specification
Integrated 16 Channel Preamp/Shaper

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Overview

These specifications are for a revised 16 channel preamp/shaper amplifier (STAR Amplifier/Shaper or SAS) for use on the STAR TPC. In general, these specifications derive from the existing PASA IC but there are some important differences.

The requested SAS design logically separates into two designs: one for the preamp and one for the shaper amplifier. There are some specifications that are specific to whole IC (for example, maximum power dissipation) and some specifications that are specific to either the preamp or shaper alone.

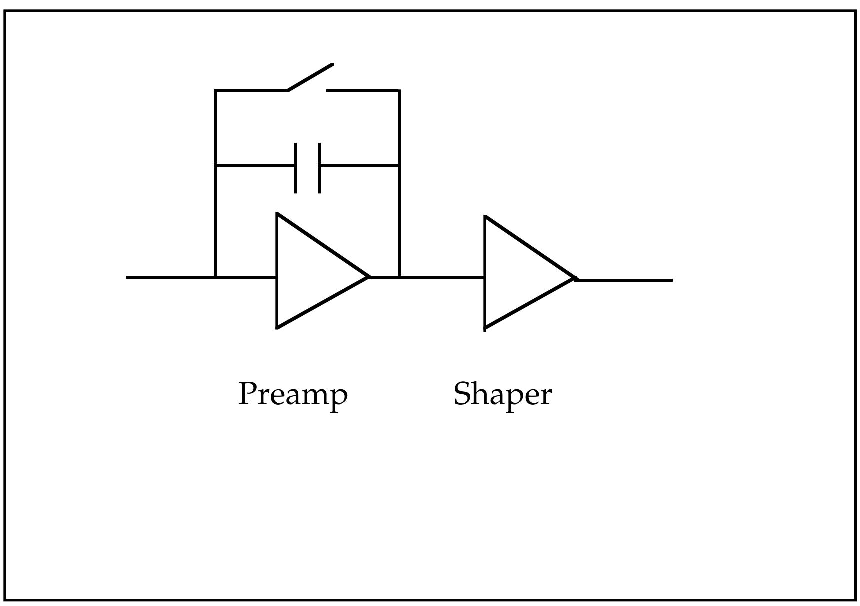

Figure 1
Block Diagram -- SAS IC

For our purposes, the preamp is configured as a resettable integrator and the shaper portion is configured as a bandpass filter. Each functional block has additional features but the primary operation of the SAS IC is as a resettable integrator followed by a bandpass filter to shape the received signals into a pseudo-Gaussian shape.

Critical Device Specifications

- Device maximum noise (combined preamp and shaper): 750 e- RMS
  - Cdetector = 25 pF
  - Output Noise Bandwidth = 10 KHz to 40 MHz
- Device Maximum Power Dissipation: <60 mW per channel
  - Measured with a reset/active period of 10/90 (90% active time)
- Device Maximum Dynamic Range: 0.7 picoCoulomb (pC)
  - Total integrated charge received on the input of 0.7 pC should degrade device conversion gain by no more than ±4.8%.
- Shaper Tail Correction: +0.5%, -0.22% within 5 μS.
  - Return to within +0.5%, -0.22% of baseline within 5 μS of pulse arrival for TPC pad current signals. (See Figure 2 for additional detail).
- Signal Dynamic Range:
  - Minimum Ionizing: 20 x System Noise = 20 x 800e- = 16Ke-
  - Maximum Signal (including fluctuations): 40 x Minimum Ionizing = 640 Ke-
- Good Pulse Resolution: ±4.8% linearity
  - For pulses with amplitudes between minimum ionizing (16K e-) and maximum signals (640Ke-) and with total integrated charge between 0 pC and 0.7 pC.
- Shaper Time Constants:
  - Peaking Time = 180 nS
  - FWHM = 180 nS
  - Pulse shape: pseudo-Gaussian upon receipt of a "TPC pad current signal"
- Fuse adjustment of critical shaping parameters.
  - Three fuses are provided with suitable ranges to allow adjustment of peaking times and FWHM time to within ±5%.
- 'DC Reset'
  - A high value resistor in parallel with the integrating capacitor provides a discharge path for accumulated charge and eliminates the need for a reset operation on the preamp.

Definitions

- Minimum ionizing signal (minis): an impulse signal of 16,000 electrons .
- Maximum signal (max_sig): an impulse signal of 40 x minis = 640K electrons. (The maximum signal for which device linearity and accuracy are within the specifications.)

DC Electrical Characteristics

Unless otherwise noted, all parameters are specified for ±5 volts (±5%) and ground supplies, 25° (±5°) C, and across all process and parameter variations.

Parameter	**Description**	**Min.**	**Typ.**	**Max.**	**Units**
Input Protection	Withstand connection to a spark equivalent to 200 pF capacitor charged to 1.4KV through a 200 Ohm resistor	5			Cycles
C_{par}	Parasitic capacitance (package and protective diode network)			5	pF
I_{din}	All digital inputs: Serial In, Serial Clock, CAL, CAL- for 0.0 ≤ input ≤ +5.0v			10	μA
V_{off}	Output offset voltage variations, channel-to-channel within one device			±0.05	Volts
V_{off}	Output offset voltage variation, across all devices			±0.1	Volts
PSRR	Power Supply Rejection Ratio	40			dB
C_{drive}	Capacitive drive capability, per output	50			pF
R_{drive}	Resistive drive capability, per output	10			KΩ
P_{diss}	Power Dissipation, 16 channel device @+5.0V supply			960	m W
CAL '0'	CAL & CAL- logic '0' (calibrator inactive) (Positive ECL levels)	+3.0		+3.4	Volts
CAL '1'	CAL & CAL- logic '1' (calibrator active)	+4.0		+4.3	Volts
Logic '0'	All digital inputs except CAL, and CAL- (CMOS compatible)	0.0		+0.5	Volts
Logic '1'	All digital inputs except CAL, and CAL- (CMOS compatible)	+4.5		+5.0	Volts

AC Electrical Characteristics

Unless otherwise noted, all parameters are specified for +5 volts (±5%) and ground supplies, 25° (±5°) C, and across all process and parameter variations.

Parameter	**Description**	**Min.**	**Typ.**	**Max.**	**Units**
V_{noise}	Noise voltage (= 750 e- @ 25 pF input capacitance)			2.25	m V
T_{RC}	Time constant of internal resistor and integrating capacitor on preamp	80		200	µS
Q_{inj}	Charge injection due to CAL changing state			100	fC
Q_{max}	Max. charge accumulation on feedback capacitor before ±4.8% gain variation	700			fC
Gain Linearity	Deviation from straight line linearity for pulses between minis and max_sig for charge accumulation between 0.0 pC and 0.7 pC			± 4.8	%
Crosstalk	Adjacent channel crosstalk with max_sig input signal driving 50 pF parallel 10 KΩ			±0.3	%
Crosstalk	Non-adjacent channels, max_sig input signal driving 50 pF parallel 10 KΩ			±0.3	%
Peaking Time	Time from receipt of a "TPC pad current signal" to the peak of the output pulse (after fuse adjustment)	170	180	190	n S
FWHM	FWHM of output signal (after fuse adjustment)	170	180	190	n S
Max swing	Maximum signal excursion	2.5			Volts
A_{cg}	Conversion gain from input charge to output voltage swing	19	20	21	mV/fC