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PULSE POWER SUPPLY REQUIREMENTS FOR THE ACOL INJECTION AND EJECTION SEPTUM MAGNETS

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1. GENERAL

The injection septum and the two ejection septum magnets both sit in the same section of the ACOL ring between the quadrupoles QDS 5301 and QFS 5401 (Figure 1). The injection septum being a 2 turn, curved, 1.6 m long magnet which is pulsed in air. The injected beam traverses this magnet gap in air and enters the machine via a window on the down stream side of QFS 5401.

The 2 ejection septa are situated in a vacuum tank between the quadrupoles. These single turn, 0.8 m long septa are electrically in series inside the tank and will connect to their pulsed power supply via a special feedthrough in the wall of the vacuum tank. Both the injection and ejection septa are connected to their respective power supplies via a pulse transformer.

Using the ACOL naming system for these magnets, they are called respectively:

Injection septum magnet	SMI 5306
Ejection septum 1 magnet	SME 5305
Ejection septum 2 magnet	SME 5307

2. INJECTION SEPTUM MAGNET

Taking the magnetic rigidity Bp = 11.93 Tm and a beam emittance of 240 π mm.mrad the injection septum parameters are :

Nominal magnetic induction	1.002	Tesla
Bending angle	7.9754°	
Radius of curvature of magnet	11.892	m
Effective magnetic length	1.65	m
Vertical aperture between poles	90	mm
Horizontal aperture between coils	111 - 119	mm
Septum width (copper + insulation + screen)	23 - 15	mm
Number of turns	2	
Coil resistance	≃ 0.3	mm
Coil inductance	≃ 12	μH
Nominal pulse current	36	kAmps
Maximum pulse current	40	kAmps
Pulse repetition rate	2.4	secs
Pulse duration (half sine) max.	5	msecs.

It should be noted that the coil resistance and magnet inductance are values calculated from the physical dimensions. The final values to be measured on the prototype magnet in January 1985 are not expected to be very different from those given above. Because of the method of fixing the coil in the curved core the reverse current in the magnet during power supply recovery should not exceed 10% of the peak value. The connection of the pulse current to the magnet will be made using a short, low inductance strip line from the transformer secondary. In order to be able to set-up the injection line into ACOL protons will be injected. For this to be feasible the polarity of the injection septum magnet power supply must be reversible. Whether this is done locally or remotely will depend to some extent on the method of machine operation. Since there will be very little space in the injection/ejection region some care has to be exercized in the positioning of the large pulse transformer for this magnet.

3. EJECTION SEPTUM MAGNETS

The emittance of the ejected beam is 25 π mm.mrad and consequently the aperture size required for these two magnets is considerably less than for the injection septum. Each of these magnets, powered in series, contributes 4° to the total bending angle.

The single magnet parameters are :

Nominal magnetic induction	1	Tesla
Bending angle	4.0°	
Effective magnetic length	0.815	m
Vertical aperture between poles	30	mm
Horizontal aperture between coils	75	mm
Septum width	3	mm
Number of turns	1	
Coil resistance	≃ 0.4	mΩ
Magnet inductance	≃ 2.5	μH
Nominal pulse current	24.3	kAmps
Maximum pulse currents	27	kAmps
Pulse repetition rate	2.4	secs
Pulse duration (half size) max.	3	msecs.

As before the coil resistance and magnet inductance are calculated values using the physical dimensions of the magnet. However in this case it should be noted that the total load impedance as seen by the power supply should also include the series connection arrangement of the two magnets in their vacuum tank. This total load impedance has been calculated as follows :

$$R_T \simeq 1 \text{ m}\Omega$$

$$R_T \simeq 6 \ \mu\text{H}$$

also no more than 5% of the peak current should pass through the magnet during the power supply recovery. At the present moment there is no plan for pulsing the ejection septa with reverse polarity, but this possibility should be discussed, in case any future test schemes might include it.

4. PULSE WIDTH AND CURRENT STABILITY

The current pulse half sine width for the injection septum will be approximately 5 msecs depending on the power supply characteristics. The flat-top time of 600 nSecs which is needed for inflecting the antiproton bunch can be obtained naturally from this pulse with the flatness $\frac{\Delta I}{I} = 10^{-4}$. A pulse to pulse stability better than 3×10^{-4} is also a requirement.

The ejection septum magnet current pulse produced by its power supply can be up to 3 msecs width. The flat-top time required for ejection of the pre-cooled antiproton bunch is 360 nsecs. The flat-top and pulse to pulse stability are the same as required for the injection septum power supply.

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INJECTION / EJECTION REGION

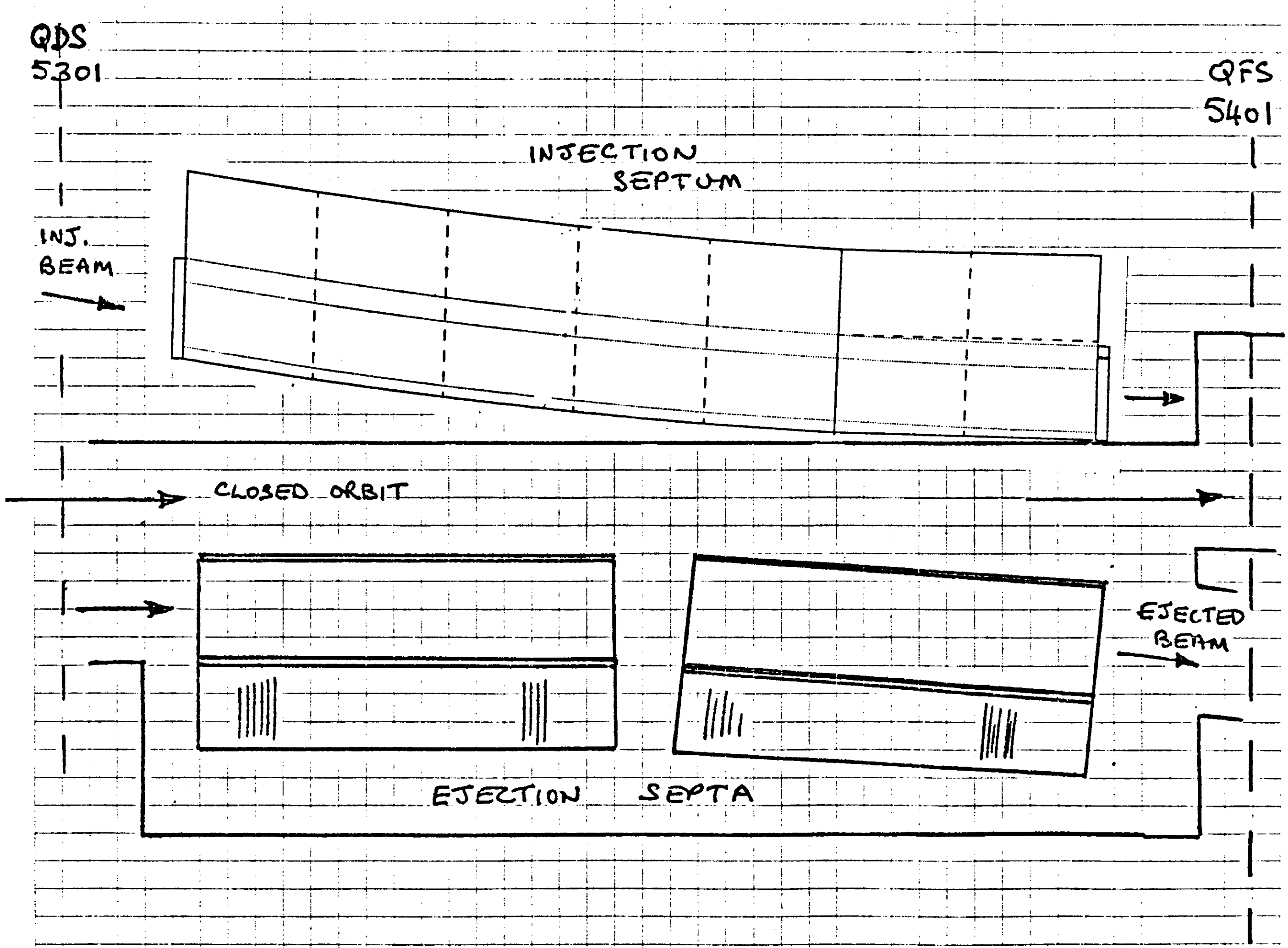

Figure 1.