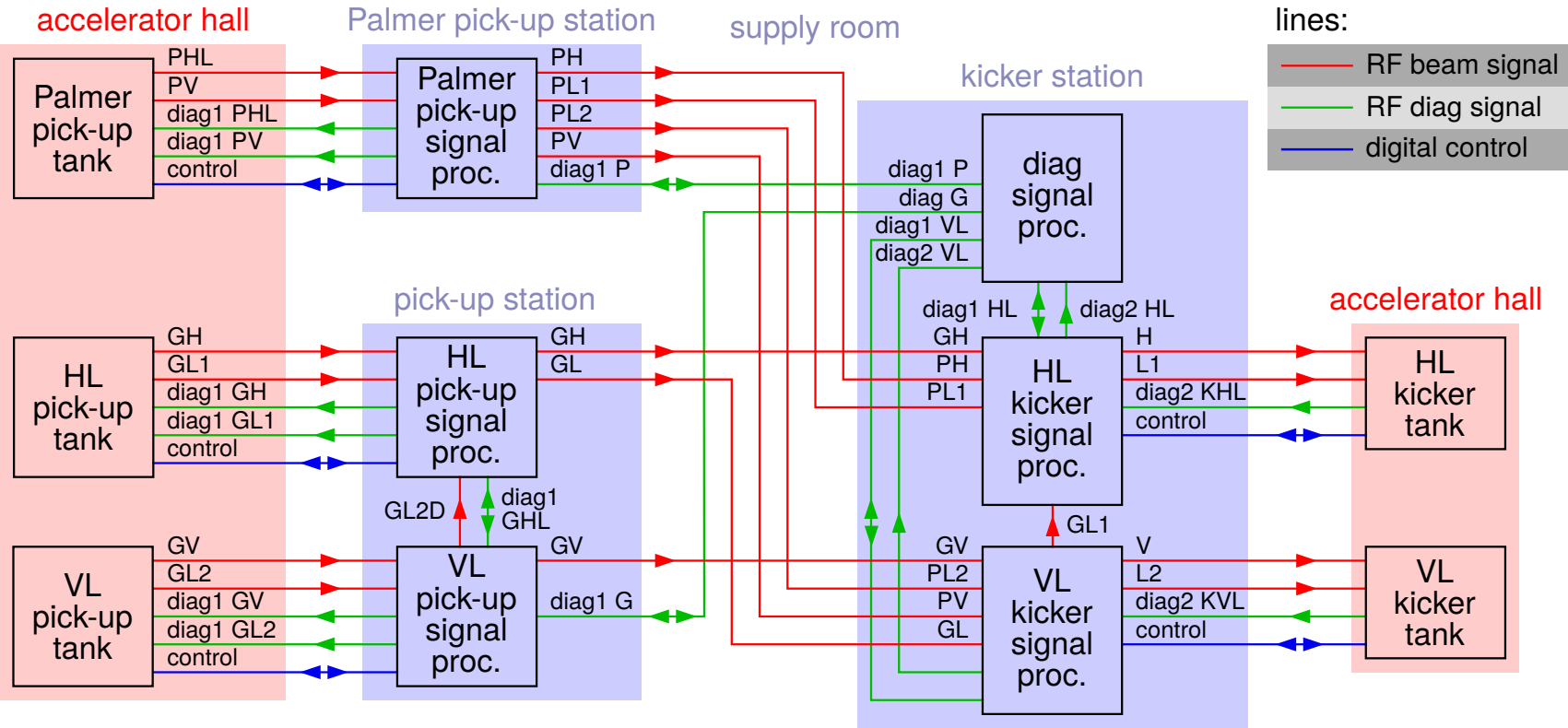
RF Signal Processing for Stochastic Cooling in the Collector Ring

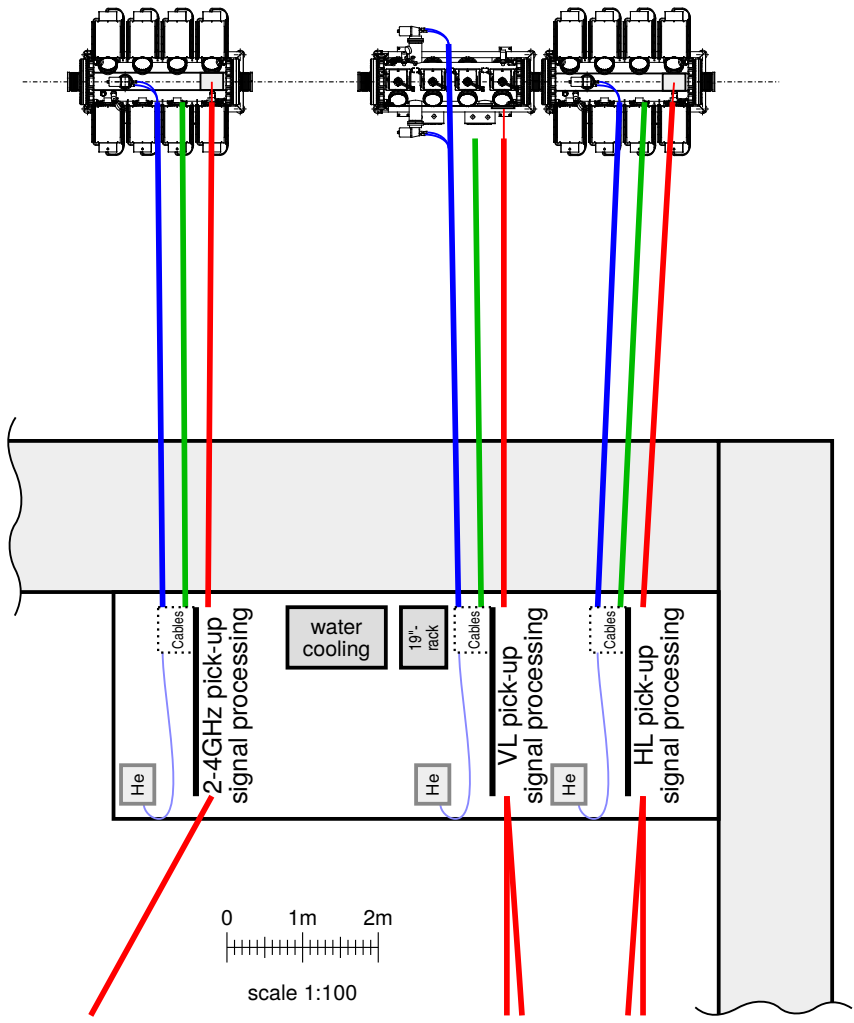
FAIR Storage Rings Meeting, 13.03.2012

Claudius Peschke

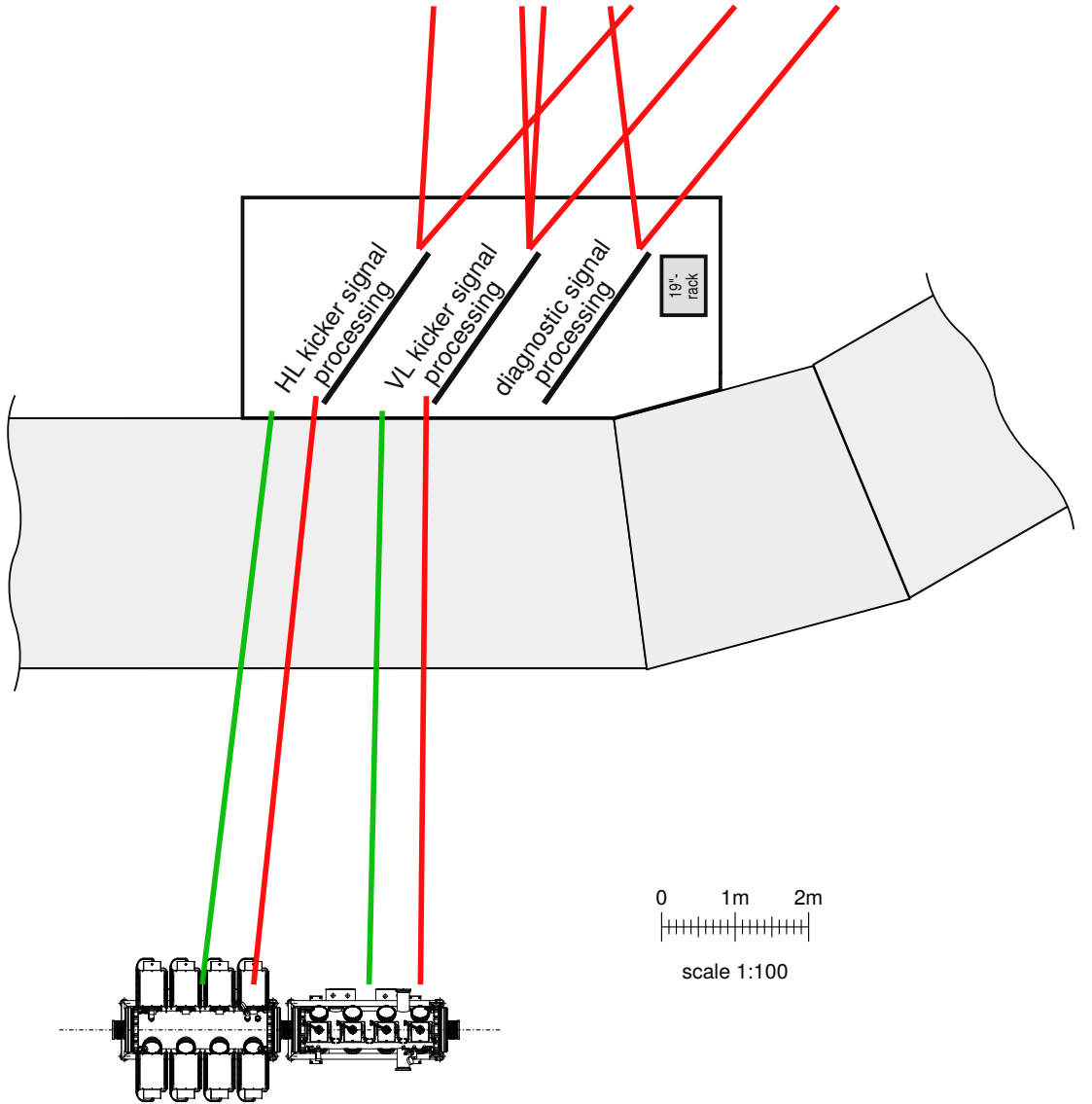
CR Stochastic Cooling System RF



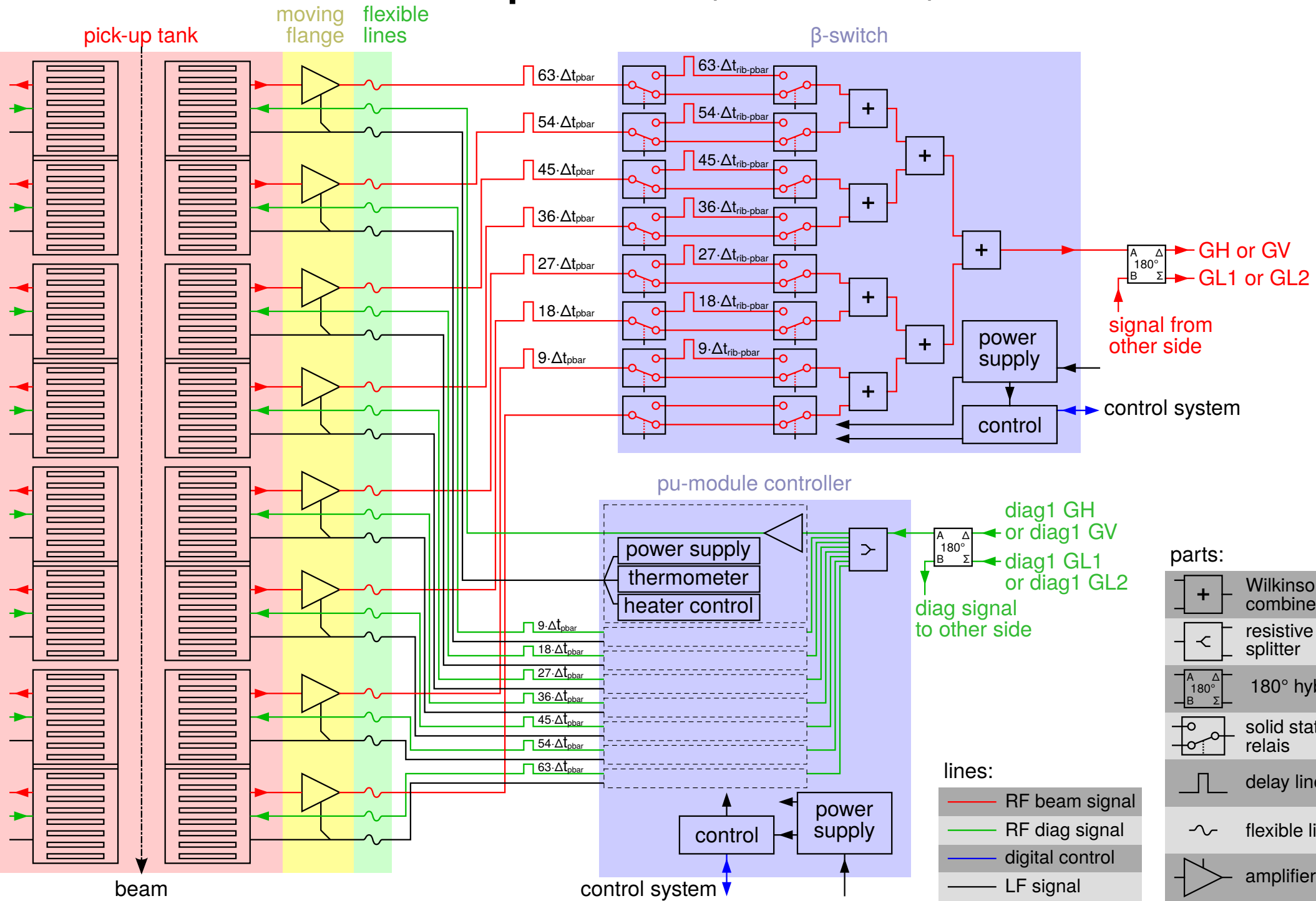
Pick-Up Area


Cables
2-4GHz pick-up signal processing
He
water cooling
19"-rack
Cables
VL pick-up signal processing
He
Cables
HL pick-up signal processing
He
0
1m
2m
scale 1:100

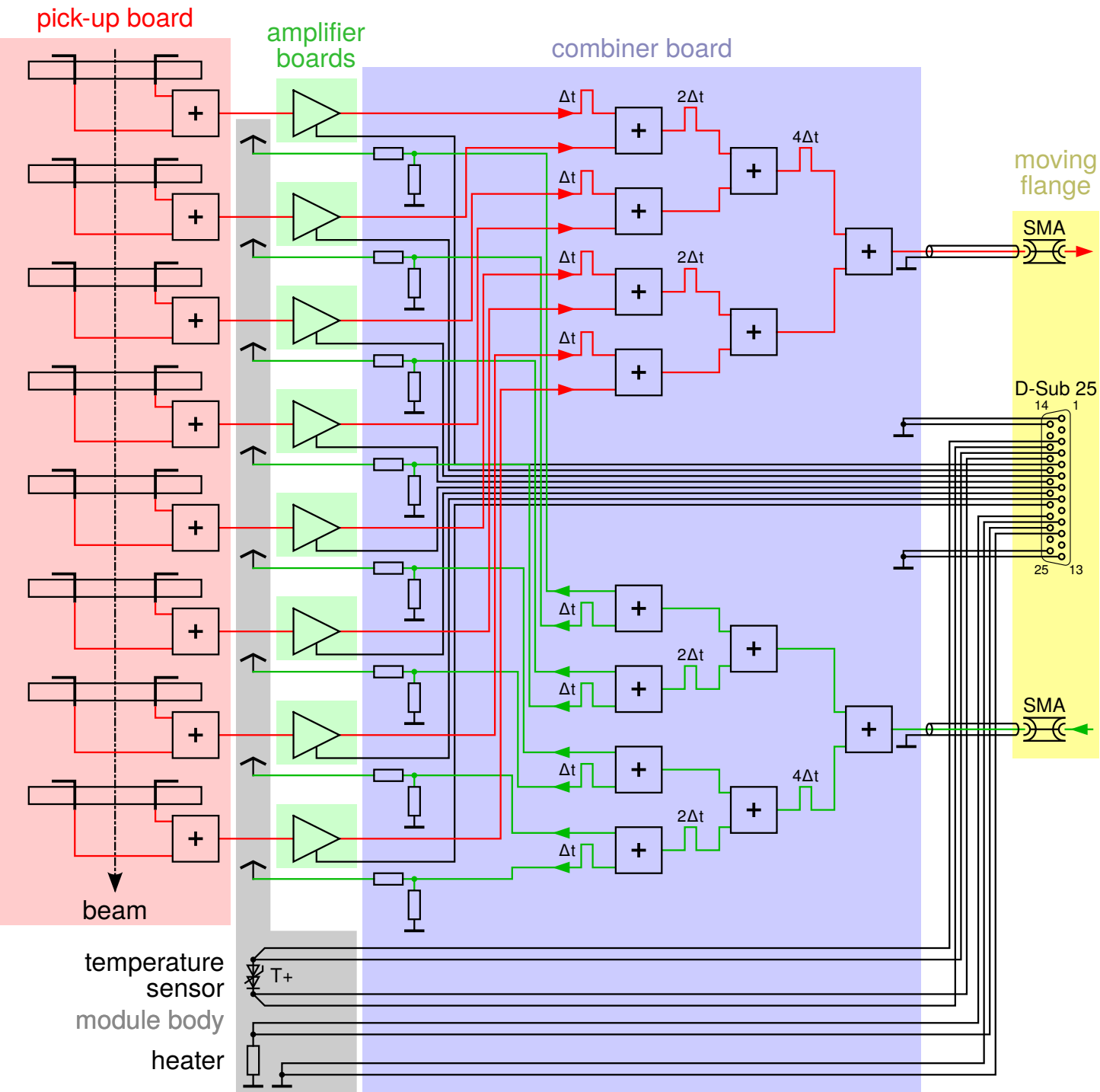
Kicker Area


HL kicker signal processing
VL kicker signal processing
diagnostic signal processing
19"-rack
0
1m
2m
scale 1:100

Pick-Up Tank RF (One Side Shown)



Pick-Up Module with Internal Amplifier



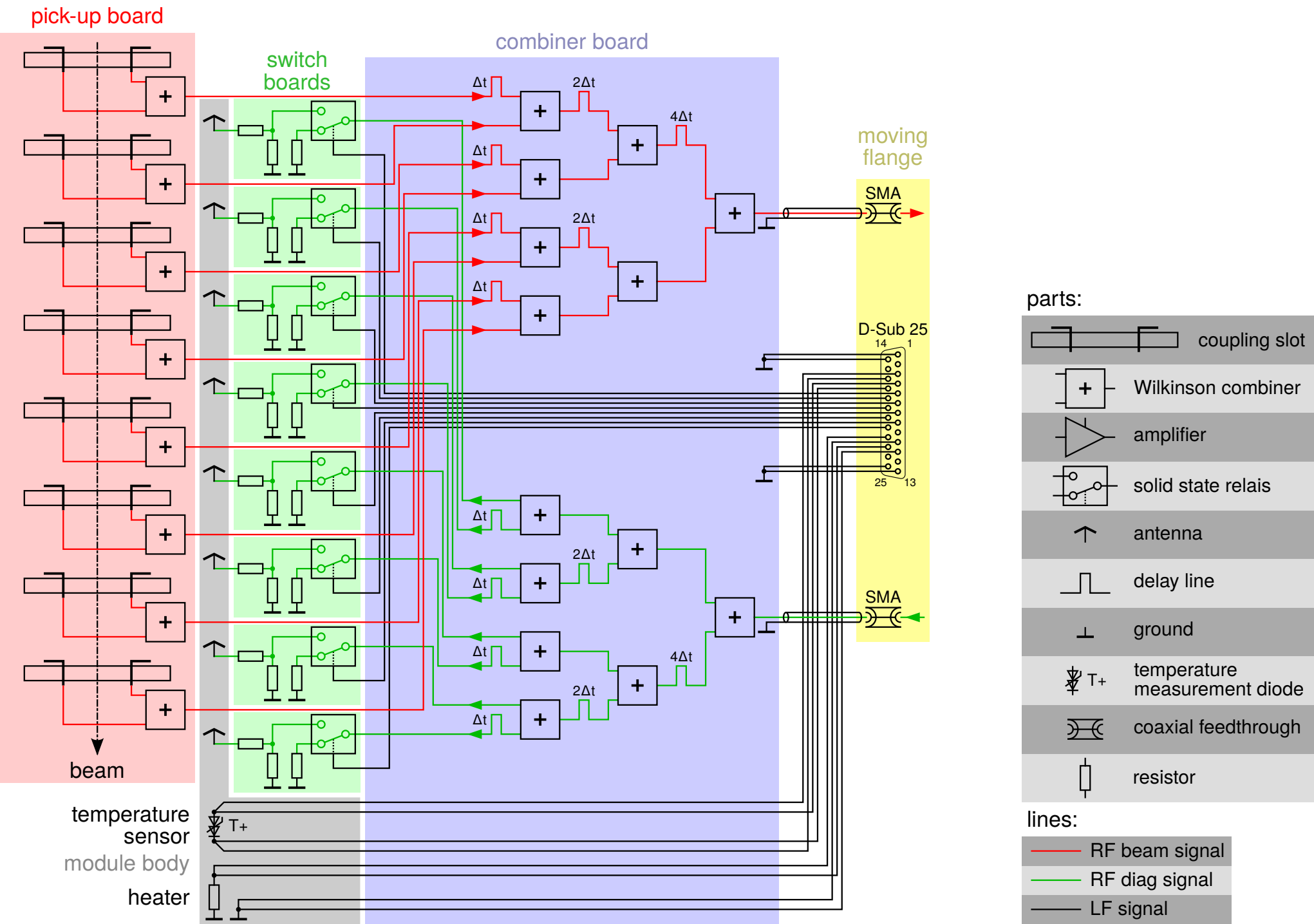
parts:

- coupling slot
- Wilkinson combiner
- amplifier
- antenna
- delay line
- ground
- temperature measurement diode (T+)
- coaxial feedthrough
- resistor

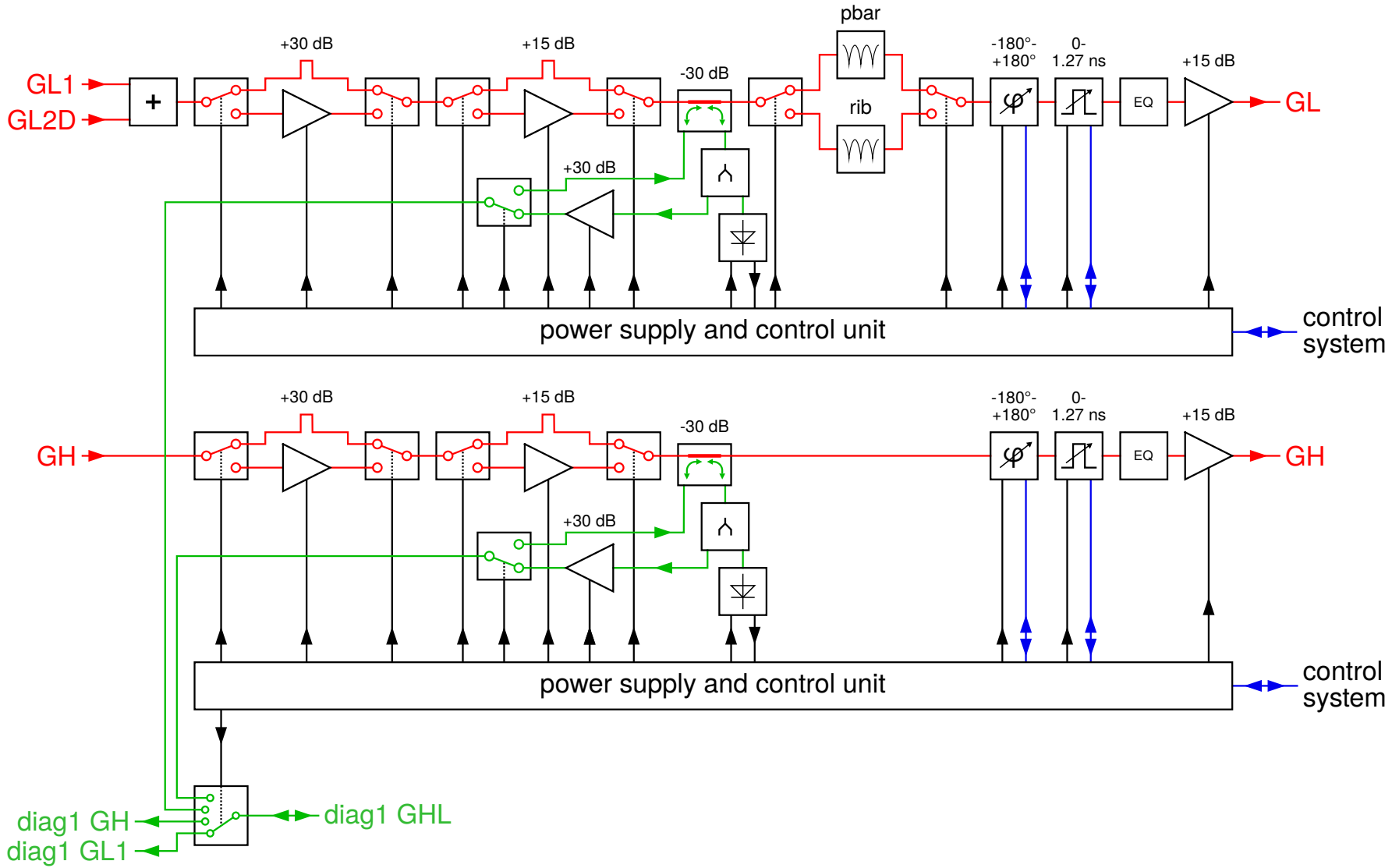
lines:

- RF beam signal
- RF diag signal
- LF signal

Pick-Up Module with External Amplifier



PU Signal Processing Horizontal and Longitudinal



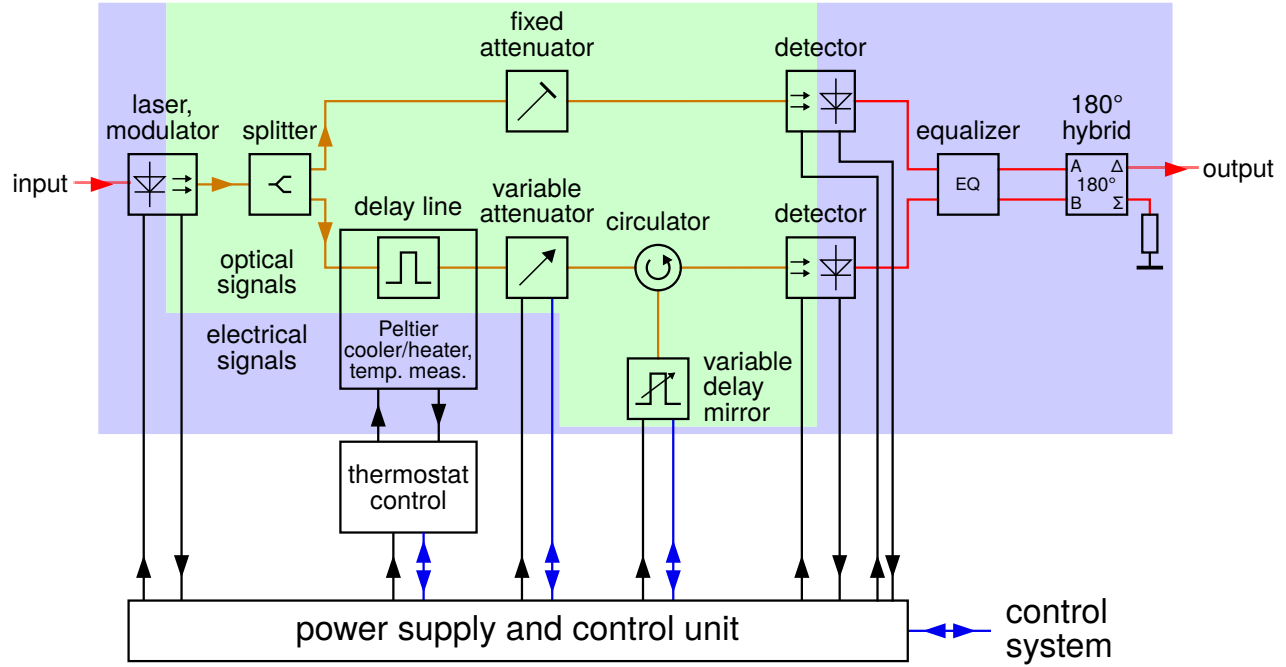
parts:

- Wilkinson combiner
- resistive splitter
- solid state relais
- delay line
- variable delay
- var. phase shifter
- equalizer
- directional coupler
- amplifier
- power meter
- notch filter

lines:

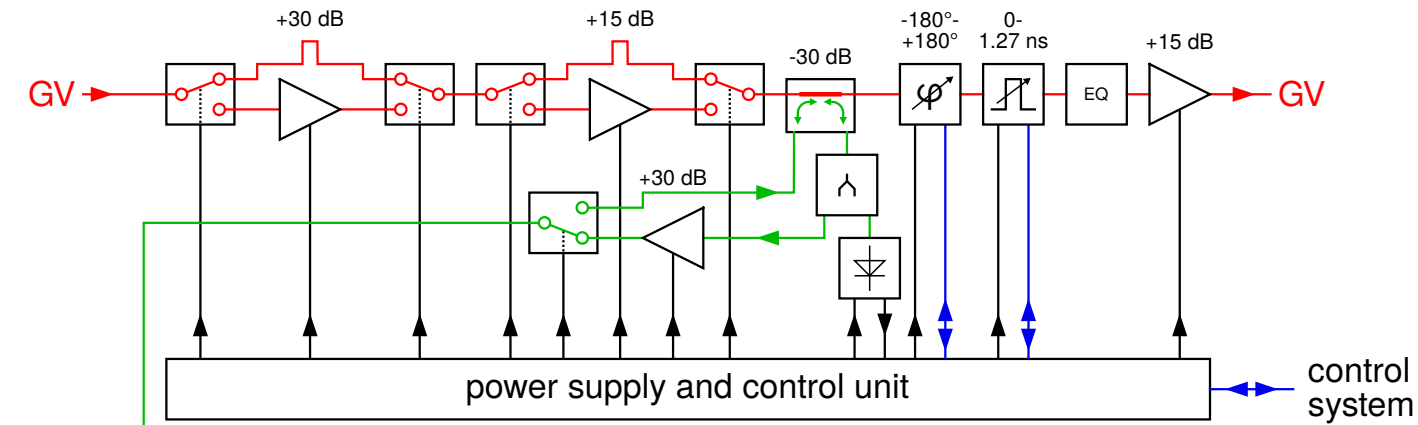
- RF beam signal
- RF diag signal
- digital control
- LF signal

Notch Filter



lines: RF signal | optical signal | digital control | LF signal

PU Signal Processing Vertical and Longitudinal



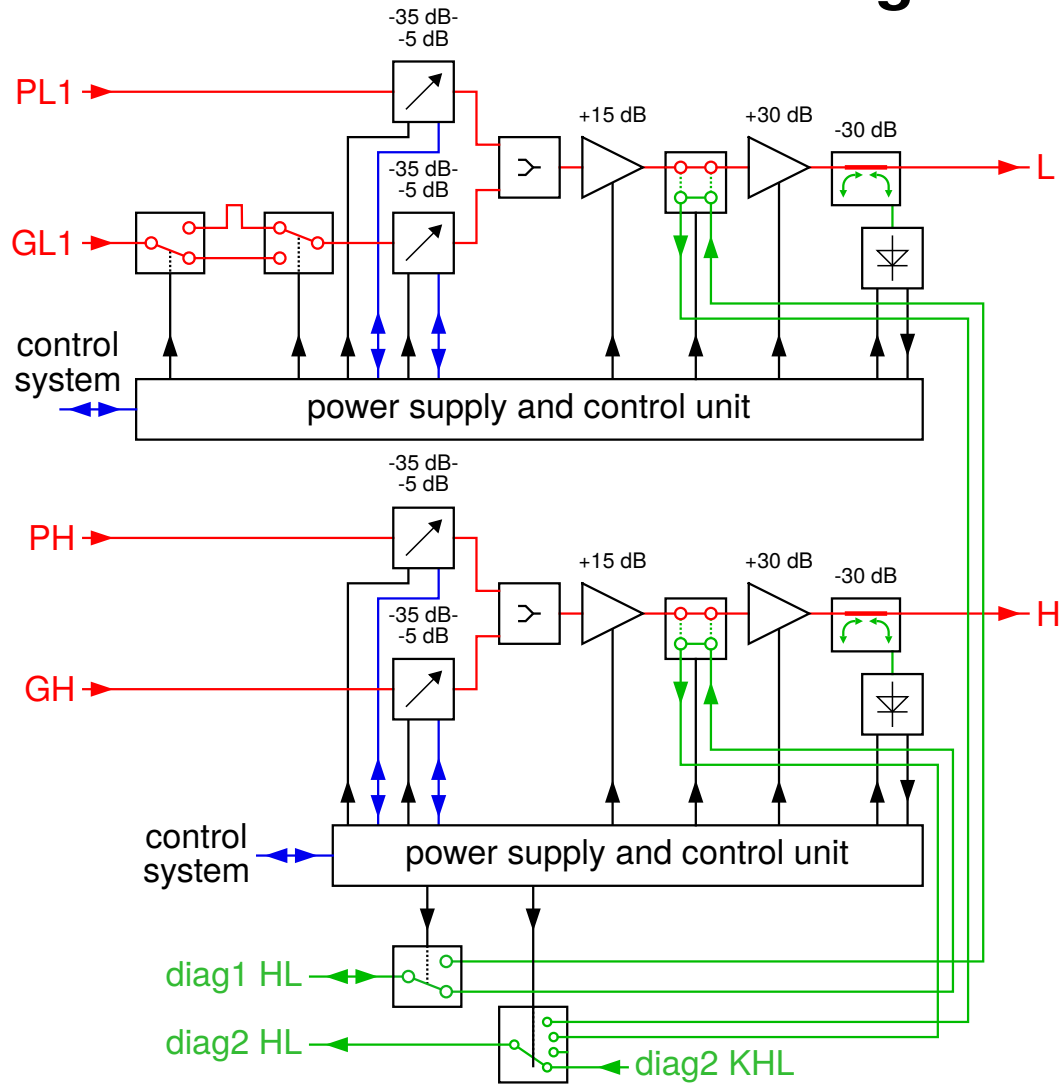
lines:

- RF beam signal
- RF diag signal
- digital control
- LF signal

parts:

- solid state relais
- resistive splitter
- delay line
- variable delay
- var. phase shifter
- equalizer
- directional coupler
- amplifier
- power meter

Kicker Signal Processing Horizontal and Longitudinal



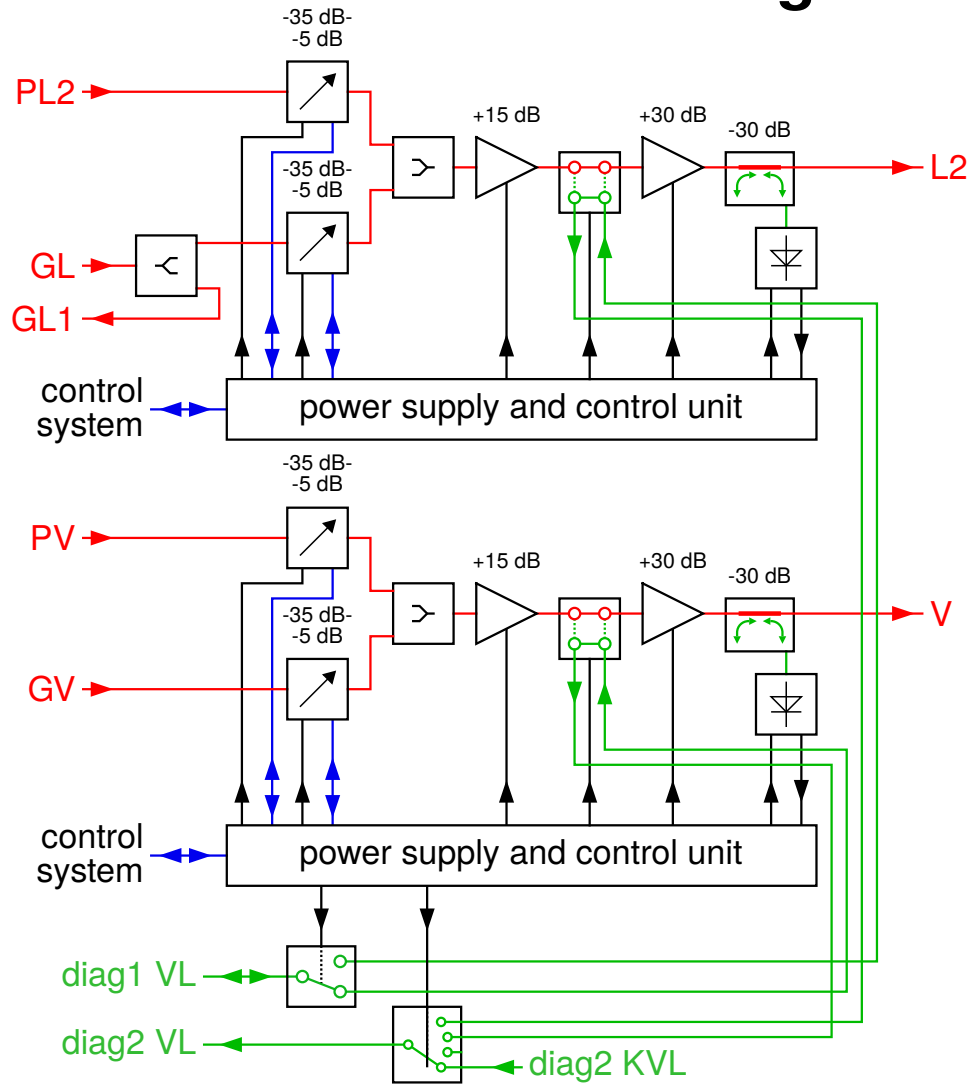
parts:

- resistive splitter
- solid state relais
- variable attenuator
- directional coupler
- amplifier
- power meter

lines:

- RF beam signal
- RF diag signal
- digital control
- LF signal

Kicker Signal Processing Vertical and Longitudinal



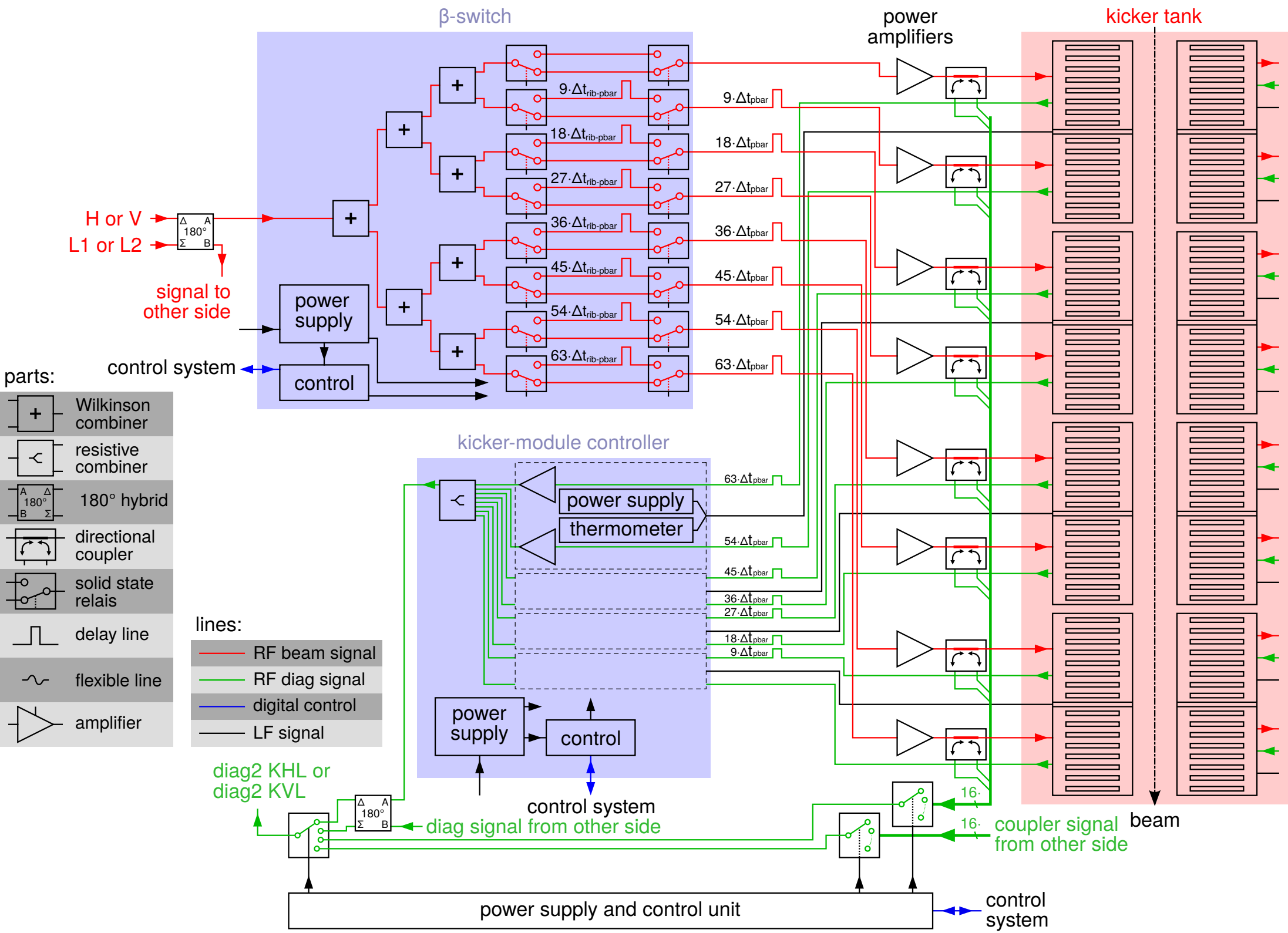
parts:

- resistive splitter
- solid state relais
- variable attenuator
- directional coupler
- amplifier
- power meter

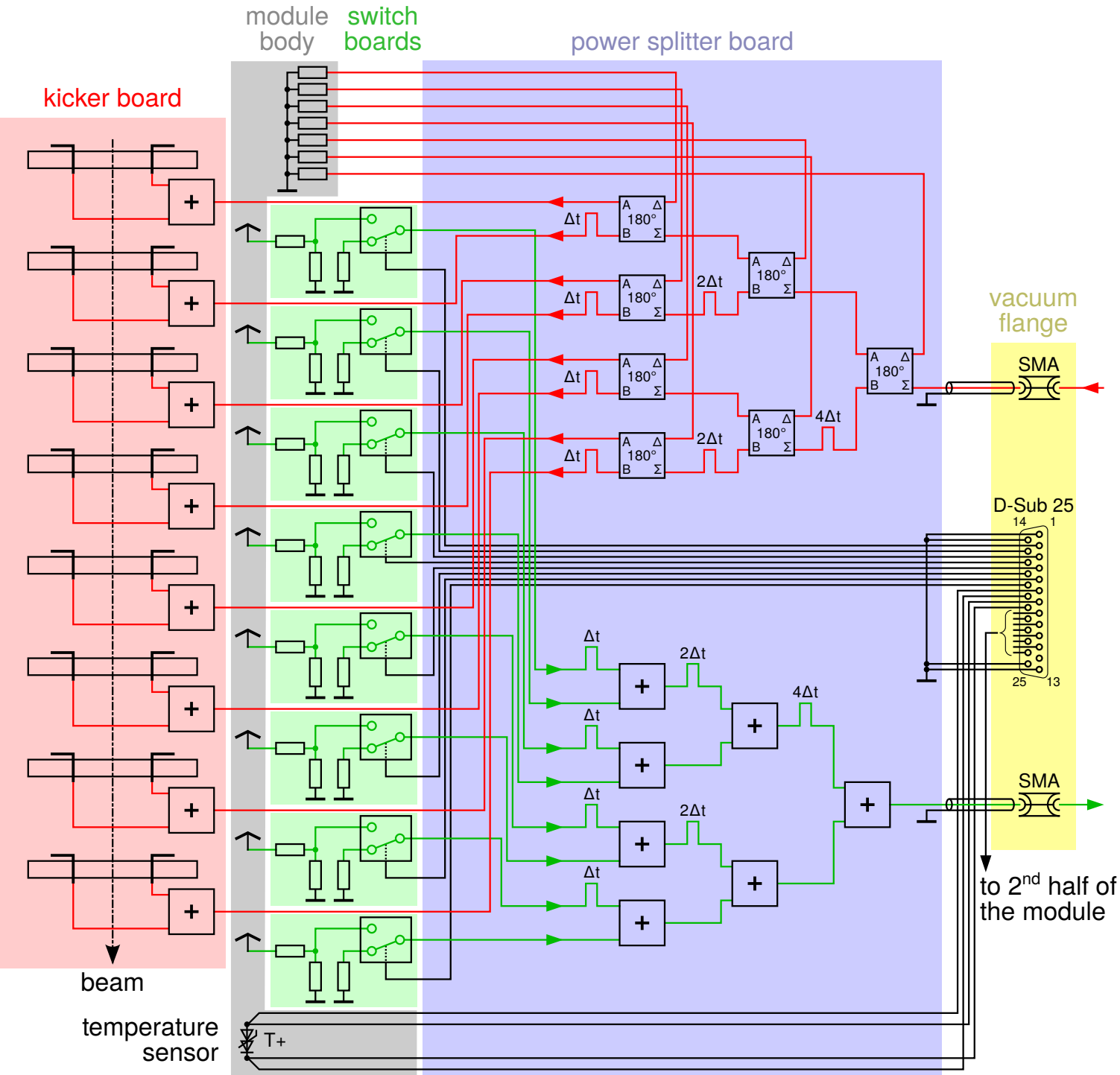
lines:

- RF beam signal
- RF diag signal
- digital control
- LF signal

Kicker Tank RF (One Side Shown)



Kicker Module



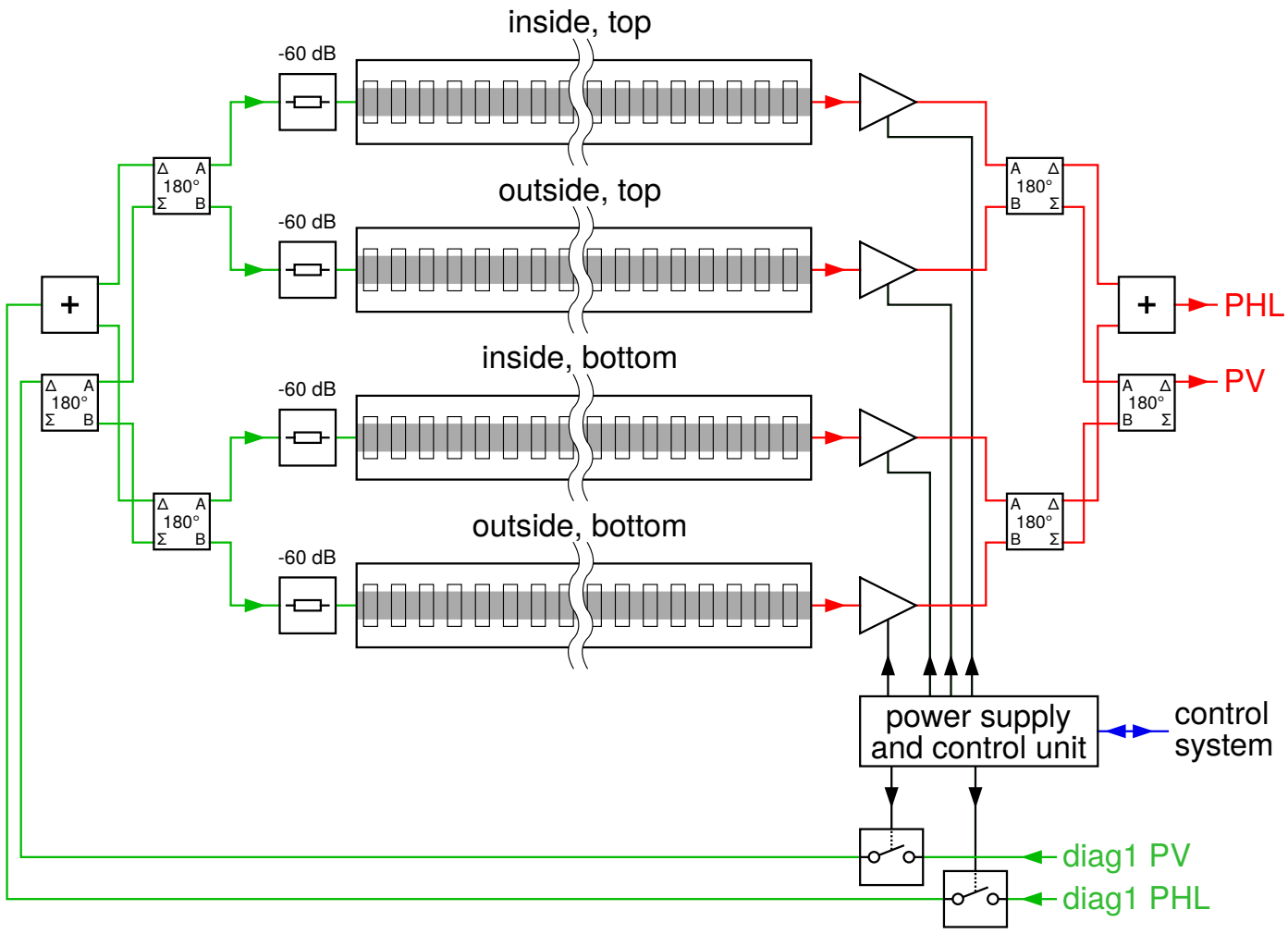
parts:

- coupling slot
- Wilkinson combiner
- 180° hybrid
- solid state relais
- antenna
- delay line
- ground
- temperature measurement diode
- coaxial feedthrough
- resistor

lines:

- RF beam signal
- RF diag signal
- LF signal

Palmer Pick-Up Tank



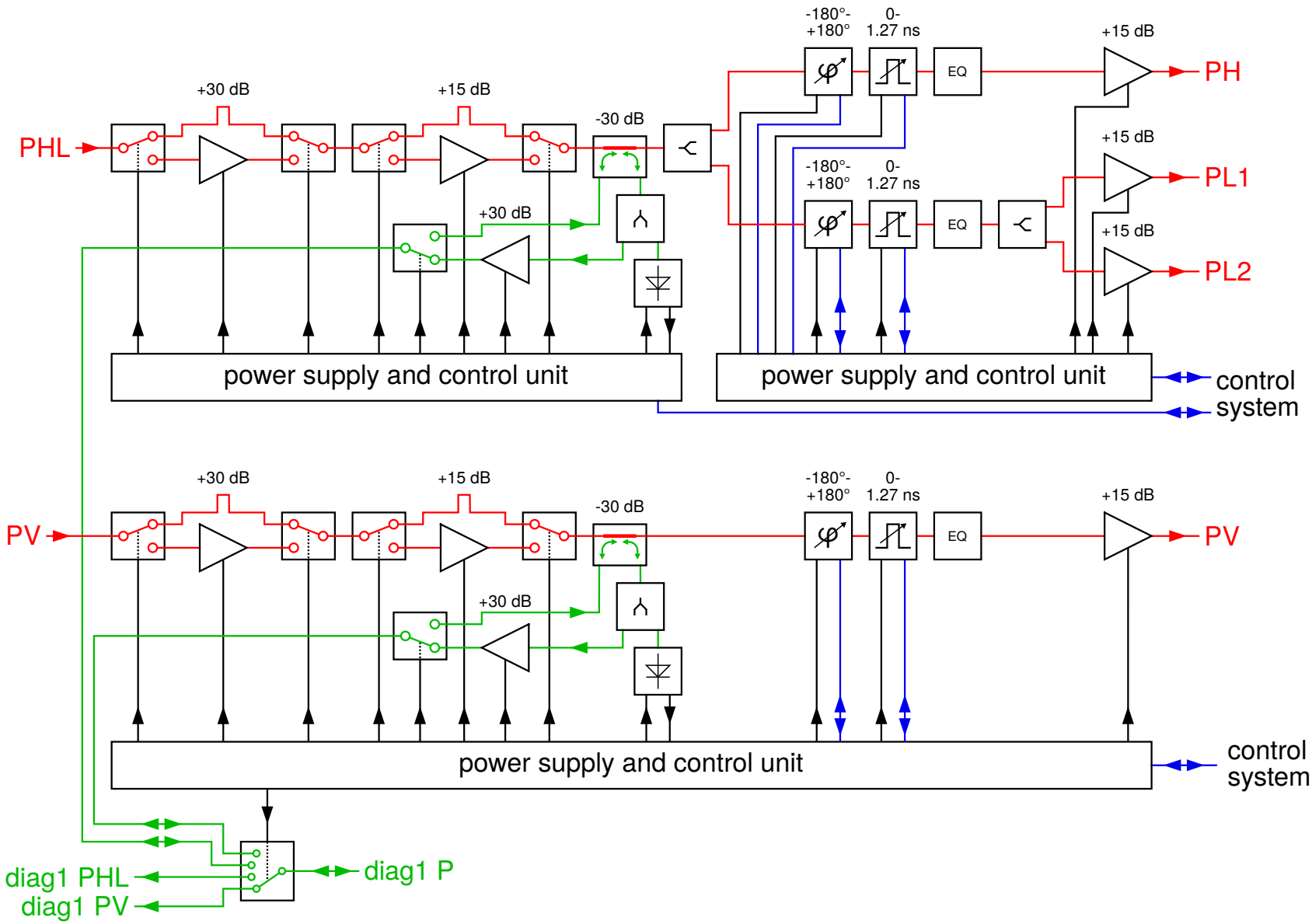
parts:

- Wilkinson combiner
- 180° hybrid
- solid state relais
- attenuator
- amplifier

lines:

- RF beam signal
- RF diag signal
- digital control
- LF signal

Palmer Pick-Up Signal Processing



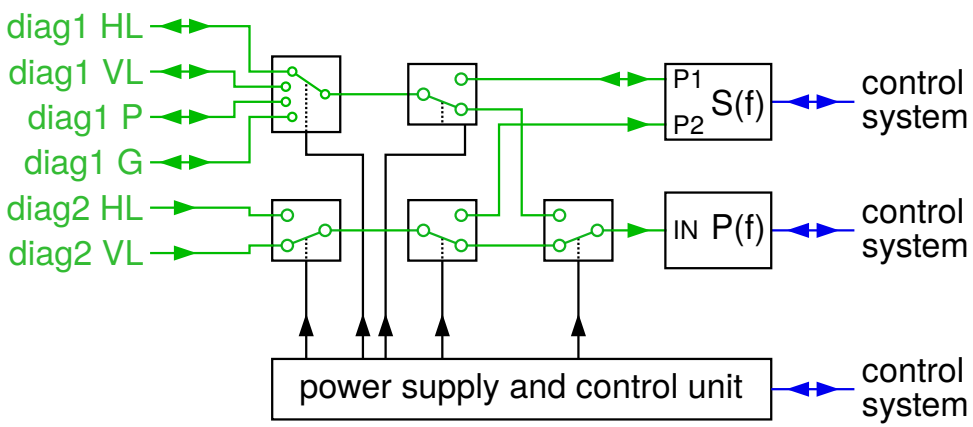
parts:

- resistive splitter
- solid state relais
- delay line
- variable delay
- var. phase shifter
- equalizer
- directional coupler
- amplifier
- power meter

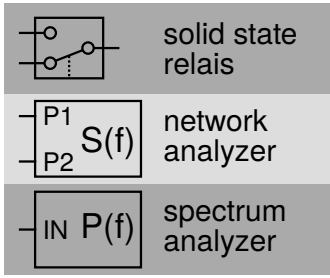
lines:

- RF beam signal
- RF diag signal
- digital control
- LF signal

Diagnostic Signal Processing



parts:



lines:

RF diag signal

digital control

LF signal

Summary And Outlook

- (preliminary) block diagram of CR stochastic cooling exists:

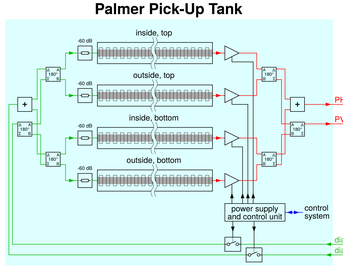
36 low noise amplifiers	6 variable delays
30 medium level amplifiers	6 variable phase shifters
32 power amplifiers	8 variable attenuators
8 β switches	2 optical var. delays
2 fiber optical modulators	2 optical var. attenuators
4 fiber optical receivers	3 non-resistive splitters
4 pu module controllers	12 resistive splitters
4 kicker module controllers	2 optical splitters
2 peltier termostat controllers	2 optical circulators
17 power supply and control units	55 solid state relais
9 embedded power meters	16 hybrids (180°)
1 embedded network analyzer	41 directional couplers
1 embedded spectrum analyzer	8 equalizers

- next: calculate power levels and delay times
  to each node of the signal paths

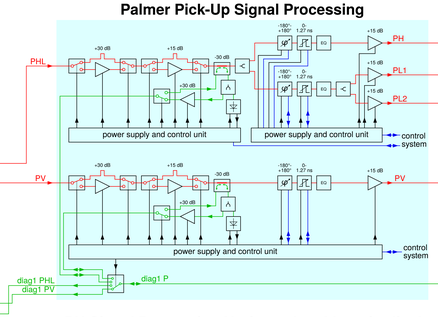
- look for components

CR Stochastic Cooling System

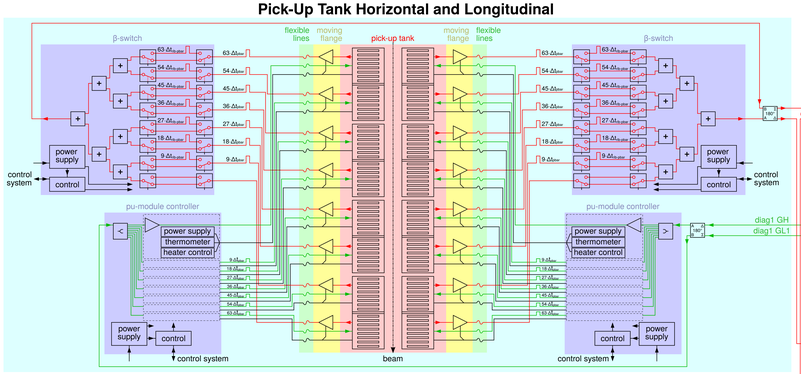
Palmer Pick-Up Tank



Palmer Pick-Up Signal Processing

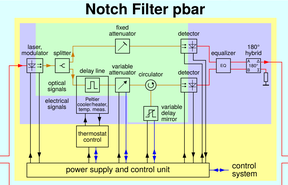


Pick-Up Tank Horizontal and Longitudinal

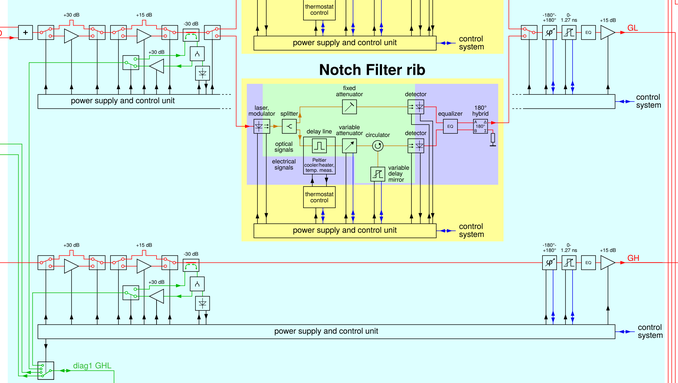


PU Signal Processing Horizontal and Longitudinal

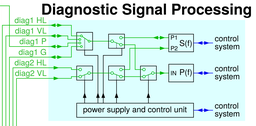
Notch Filter pbar



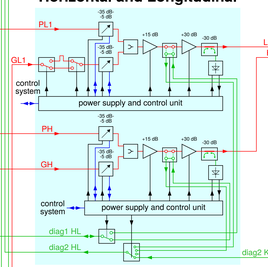
Notch Filter rib



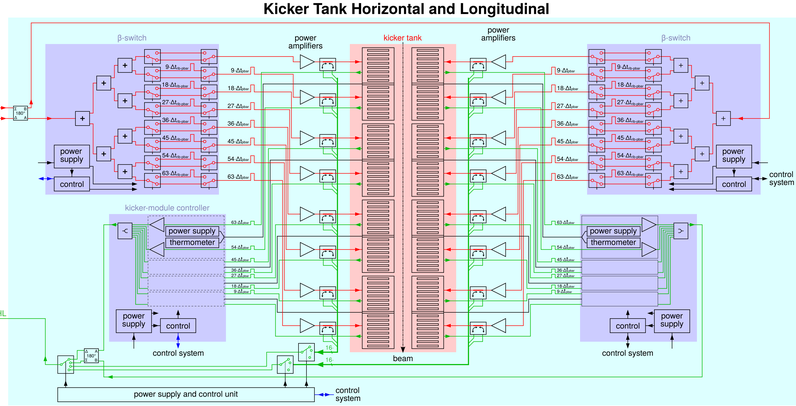
Diagnostic Signal Processing



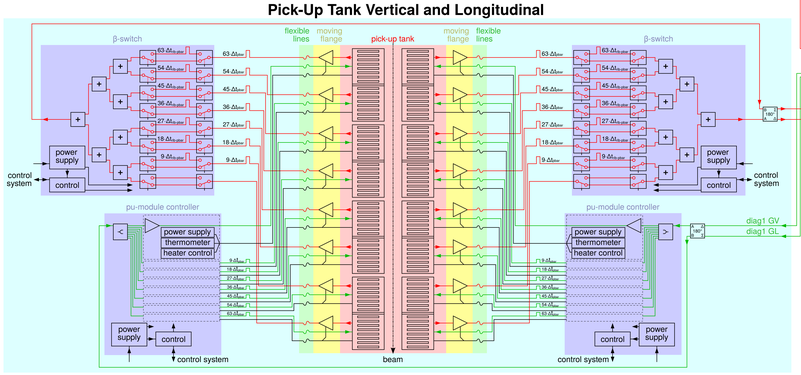
Kicker Signal Processing Horizontal and Longitudinal



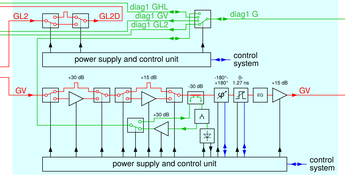
Kicker Tank Horizontal and Longitudinal



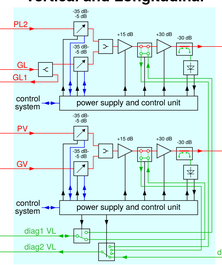
Pick-Up Tank Vertical and Longitudinal



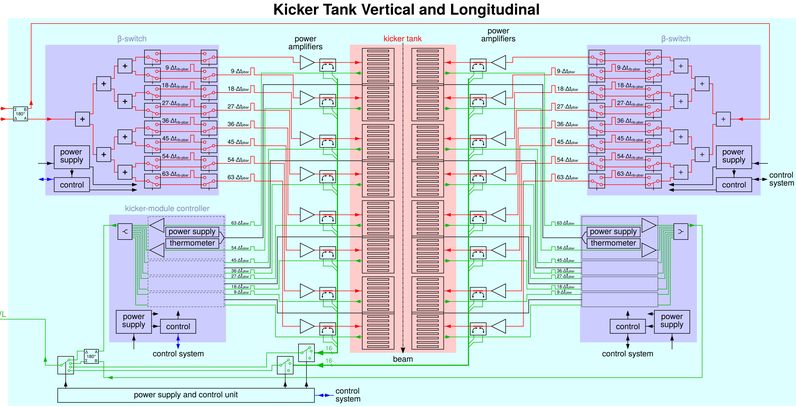
PU Signal Processing Vertical and Longitudinal



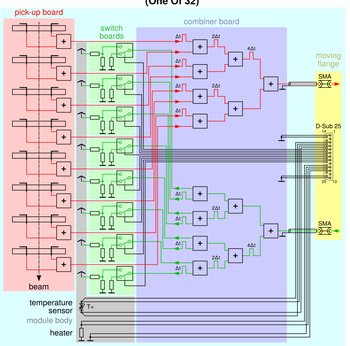
Kicker Signal Processing Vertical and Longitudinal



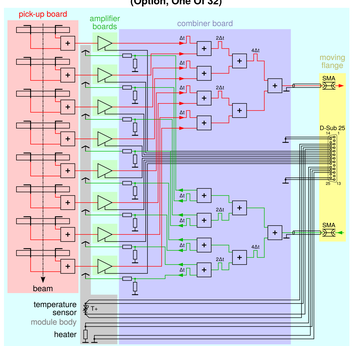
Kicker Tank Vertical and Longitudinal



Pick-Up Module with External Amplifier
(One Of 32)



Pick-Up Module with Internal Amplifier
(Option, One Of 32)



parts:

- Wilkinson combiner
- resistive splitter
- delay line
- flexible line
- ground
- antenna
- resistor
- temperature measurement diode
- coupling slot
- coaxial feedthrough
- solid state relais
- 180° hybrid
- equalizer
- directional coupler
- variable delay
- var. phase shifter
- variable attenuator
- attenuator
- amplifier
- power meter
- network analyzer
- spectrum analyzer

lines:

- RF beam signal
- RF diag signal
- optical signal
- digital control
- LF signal

Kicker Module (One Of 32)