

CL021A

21.26 MHz Integrated MRI Receive Coil Feed Board



General Description

The CL021A is an integrated magnetic resonance imaging (MRI) receive coil feed board assembly. It simplifies multi-channel coil integration, higher coil blocking impedance, and achieves higher SNR results. The (1) integrated Lattice Balun which provides common mode suppression, (2) low input impedance pre-amp, (3) pre-amp input protection, and (4) coil de-tune circuitries are built-in. The preamp's very large noise circles allow a variety of coil types without compromising SNR. Simply connect a coil loop and an output signal cable to complete each high performance coil channel design.

Key Features

- For MRI frequency of 21.26 MHz
- Blocking Impedance: $>60 \Omega$ (typical)
- Common Mode Suppression: >35 dB
- Recovering Speed: $2 \mu\text{s}$
- Integrated Lattice Balun
- Built-in Low Input Impedance Pre-amp
- Preamp Noise Figure: 0.40 dB
- Coil De-tune Control Port provided
- Maximum Input MRI TX power²: 70 dBm
- Non-Magnetic
- RoHS Compliant
- Made In USA

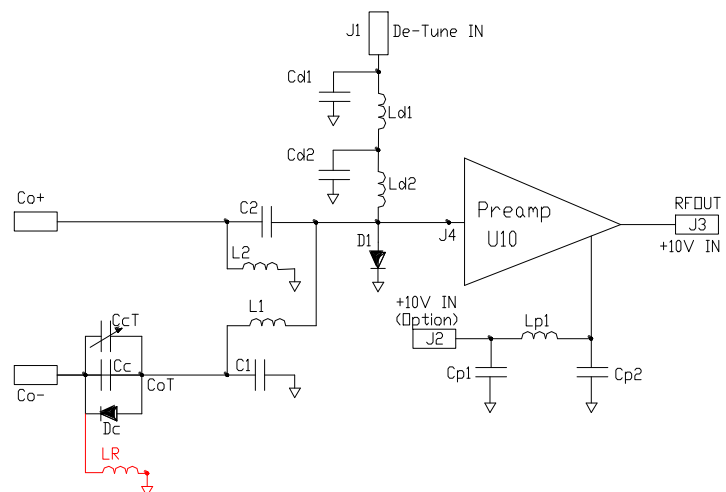
Absolute Maximum Ratings¹

- 70 dBm maximum input MRI TX power² at Co+ and Co- (with coil loop detuning activated)
- +7V ~ +12V DC voltage (V_{dd})
- +20V De-tune Voltage (V_{dt})
- 2KV ESD Human Body Model
- ± 250 mA De-tune current (I_{dt})
- +10 °C ~ +60 °C Operating Temperature
- -40 °C ~ +85 °C Storage Temperature

Ordering: CL021A

- Options are available per Questionnaire

Block Diagram



Note: L_R is required to be selected and installed properly by the user to allow sufficient coil loop detuning.

¹ Operating beyond these limits may cause permanent damages.

² With >10 dB coil loop detuning and at least 25 dB geometrically isolation attenuation in place.

Electrical Performance

Parameter	Conditions	Min	Typical	Max	Unit
P_{IN}	21.26 MHz, TX signal, detuned coil loop, at Co+ and Co- <i>with sufficient L_R installed</i>			70	dBm
Z_B	Blocking Impedance, Ports CoT and Co+	60			Ω
S_{co}	Common Mode Suppression at 21.26 MHz	35			dB
G_A	Preamplifier Gain at 21.26 MHz		28		dB
NF_A	Preamplifier Noise Figure at 21.26 MHz		0.40		dB
Z_A	Preamplifier Input Impedance at 21.26 MHz		1.8		Ω
S_{22}	Output Return Loss at 21.26 MHz	20			dB
OIP_3	Output IP ₃ , -3.0 dBm Each tone, 1 MHz Separation	18	22		dBm
$P_{0.1dB}$	Output Power 0.1 dB Compression Point	0	3		dBm
P_{1dB}	Output Power 1 dB Compression Point	7	10		dBm
T_r	Recovering Speed, 20 dBm Input Power		2	4	μ S
I_{DD}	Current Consumption		16		mA
V_{DD}	Power Supply Voltage	+7	+10	+12	V
V_{DT}	Positive Detune Step Control Signal		+15	+20	V
I_{DT}	Positive Detune Step Control Signal			250	mA
$TEMP_O$	Operating Temperature	+10		+60	$^{\circ}$ C
$TEMP_s$	Storage Temperature	-40		+80	$^{\circ}$ C

Performance and Application

A. Cc/CcT Selection

As shown in the [Block Diagram](#), a coil loop can be connected between Co+ and Co- ports. The loop and Cc and CcT on the board together resonate at 21.26 MHz. Depending on the length or equivalent inductance of the loop, Cc and CcT can be installed, and CcT can be trimmed by the user accordingly. **Low loss, 500V rating, and high Q capacitors are required.**

Cc and CcT can be installed on a coil loop instead on the feed board. On board Cc and CcT allow a designer to use a flex loop or even a wire loop where it is hard to install Cc and CcT. Factory pre-install Cc and CcT are with the capacitance of 18 pF and 5 ~ 20 pF, respectively.

B. Detuning (TX Decoupling)

The coil loop detuning is done by tuning on the diode Dc for shorting Cc. The detuning signal is applied at port J1 during the TX transmission cycle. The diode Dc is turned on through the DC path along inductor L_1 and then L_R to the ground. The entire coil loop is detuned due to short circuit of Cc. L_R is needed to provide the detuning signal return, should the detuning signal is not desired going through the loop or there is DC blocking capacitor is installed on the loop.

For the negative de-tuning signal, Dc and D1 polarities need to be reversed. **Consult factory for the correct diodes installation.**

The current limiting resistor is required to limit the detuning current. The maximum de-tune path average current is 250 mA. Without the limiting resistor, the RF chokes in the de-tune path will be damaged.

With the applied detuning signal, the diode D_1 is turned on which makes very high TX blocking impedance at the Co+ and CoT during the transmission cycle.

Improper detuning can cause pre-amp failure by the TX signal.

C. Blocking Impedance

Typical $>60 \Omega$ Blocking Impedance at 21.26 MHz can be achieved. **Fig. 1** is a typical measured Blocking Impedance performance.

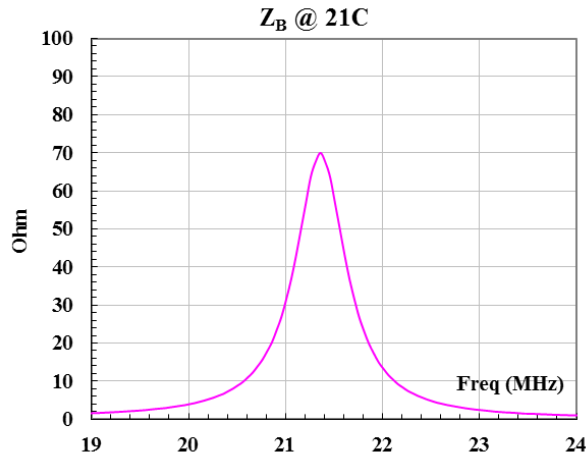


Fig 1. Blocking Impedance Z_B

D. Probed Assembly Performance

Figure 2 and Figure 3 are typical S_{21} and S_{22} performance when the VNA Port1 is connected to a wideband antenna; VNA Port 2 is connected to the preamp output; and the preamp is biased at output port @ 10V.

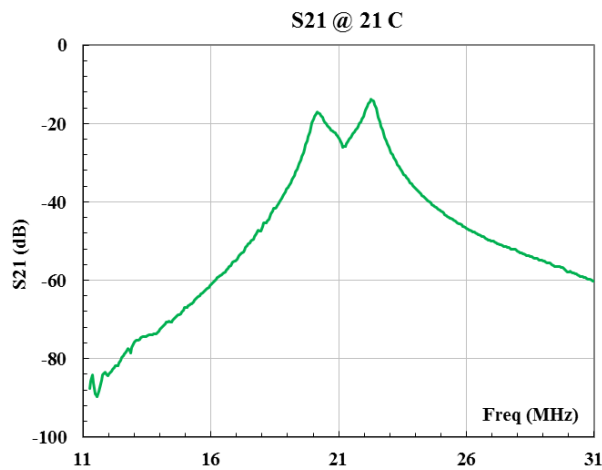


Fig. 2 S_{21} Performance

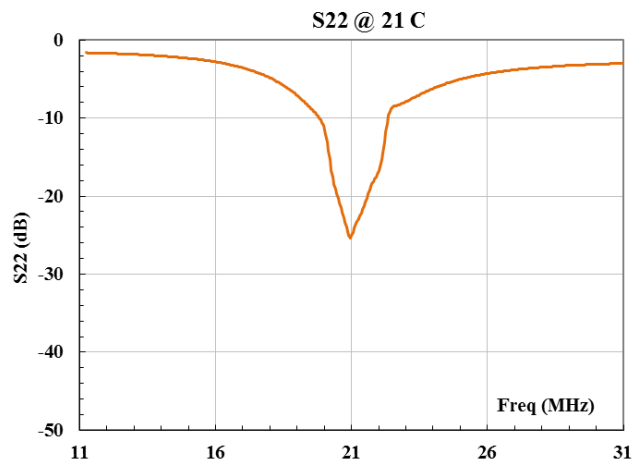
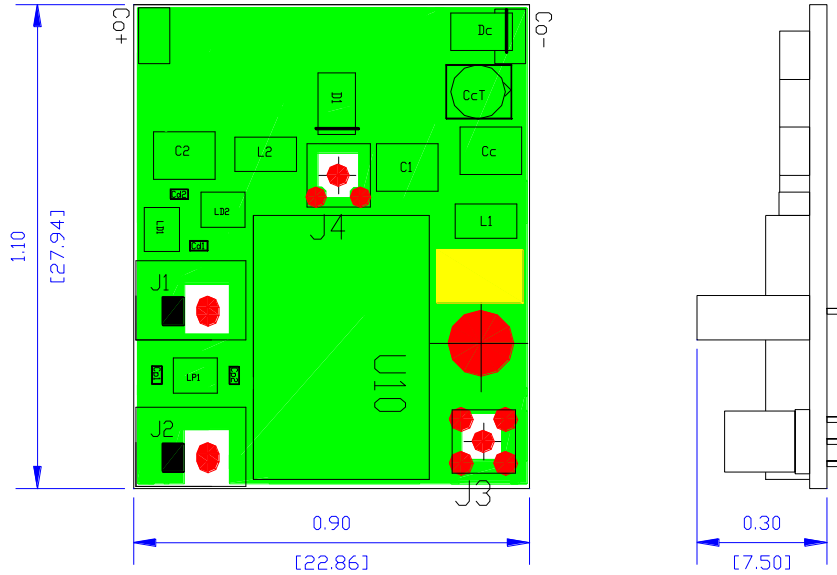


Fig. 3 S_{22} Performance

E. Coil Loop Selection

CL021A leaves the coil designer with simplified high performance coil design. Any type of coil loops can be used. Very large noise circles of integrated on board preamp forgive the large source impedance variation caused by the coil loop without degrading SNR. Flexible loops, wire loops, etc. are suitable as long as loops resonate at the MRI frequency of 21.26 MHz with the on board capacitors, Cc and CcT.

F. Outline



J1: 2.0 mm pitch/Disconnectable Crimp Style Connector

Part Number: B2B-PH-K-S(LF)(SN)

J3: PCB Mount MMCX Connector, Straight Jack

PCB Material: FR-4

Unit: Inch

[mm]

Tolerance: X.XX ±0.01"

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