NoiseTech Microwaves Ltd.

Product Technical Specifications of 100 MHz to 6GHz Controller and Thermalized Impedance Generator for Cryo Applications
(P/N C-IG0160CT)
Rev. 1 – November 15, 2020

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2. General

NoiseTech Microwave's 0.1MHz to 6GHz impedance generator (P/N C-IG0160CT) is specifically designed for "cold" noise-parameter measurements. This is an upgraded version of its first iteration (P/N C-IG0160C).

C-IG0160CT consists of a controller and an RF part that are interfaced with three low-frequency control lines. Additional interface options include a temperature sensor, cold-attenuator/termination switch, and bias-T. The RF part of the impedance generator is placed inside the dewar. Noise-parameter measurement may be accompanied with the internal "cold attenuator" or "cold termination" method.

The small size and fully electronic design permit noise-parameter measurements of packaged and on-wafer devices extending to frequencies as low as 0.1 GHz. (Lower frequencies are possible on request). The proprietary wideband impedance-generation method allows for quick and precise measurements of noise parameters over a large number of frequencies. On-board memory stores calibration data and documentation.

The impedance generator is designed to reduce thermal resistance between its enclosure and internal circuitry.

Fig. 1: C-IG0160CT Cryo Impedance Generator and Controller.

3. Ordering information

Typical part number: C-IG0160C(T)-A15-Temp
In this part number:

- "01" specifies the lower-frequency range of 0.1GHz
- "60" specifies the upper-frequency range of 6.0GHz
- "A15" stands for a 15dB cold attenuator (optional). To specify a 50Ω cold attenuator, replace "A15" with "T50"
- "Temp" specifies a temperature sensor (optional)

Typical specifications are shown above. Contact NoiseTech for other attenuation values and frequency ranges.

4. Specifications

4.1 Physical specifications

Controller

Parameter	Specification	Note	Comment
Housing/Enclosure Dimensions Width Length Height	 4cm 8cm 2.5cm		Excluding connectors.
Non-RF connectors	USB-A (controller) Mini USB (controller) Three low-speed SMA (controller) Att/Term. control (controller) Temperature sensor (controller)	Fig. 1	For control other devices Power and control input Control of the RF part Att/Termination control and Temperature sensor are optional
Total weight	125 g typ.		

Cryogenic RF Part

Parameter	Specification	Note	Comment
Housing/Enclosure Dimensions Width Length Height	 57mm 37.53mm 16mm		Excluding connectors.
RF connectors	2 RF connectors	Fig. 1	- SMA standard
Non-RF connectors	8 low frequency		5 feedthroughs 1 SMA for DUT bias
Total weight	80 g typ.		
Mounting options	- Top side through mounting slots - Bottom side mounting threaded holes		For dimensions see Fig. 3
Power consumption	0.2mW max		
Thermal resistance	0.1 K/W max		From the circuit ground plane to the bottom of the enclosure

4.2 Electrical performance at 25C

4.2.1 Digital

Parameter	Specification	Note	Comment
Communication protocol	USB 2.0		Connection thru micro-B USB
On-board RAM	192kB min.		
FLASH memory	5 MB min.		
Maximum COM Baud Rate	115.2 kbps		

Cryo Temp. Sensor error	0.5K max		Requires calibration

4.2.2 RF

Parameter	Specification	Note	Comment
Number of impedance states	4		Optimally selected for noise parameter measurements
Generated impedances within each of 4 regions	1		at each frequency within the operating range
THRU state return loss	20dB typ. 15dB min.		100MHz to 4GHz
	15dB typ. 8dB min.		4GHz to 6GHz
THRU state insertion loss	3dB typ		
Impedance switch time	1 ms max		
RMS repeatability	60 dB min		Over the full temperature range
Input P1dB	30 dBm min		
Temperature measurement range	1.4K to 325K		
Temperature measurement accuracy	<1K typ. below 60K <2K typ. above 60K		

4.2.3 Non-RF interface (Controller)

Connector (Vdd): SMA female

Pin	Name	Description
Inner	Vdd = 3.3V typ 3.2V<Vdd<3.4V Current draw: 100uA max	Power supply for the RF part

Connector (S1): SMA female

Pin	Name	Description
Inner	RF part control S1 0V<V_{OL}<0.4V 2.7V<V_{OH}<3.3V Current source: 50uA max	Control of the RF part

Connector (S2): SMA female

Pin	Name	Description
Inner	RF-part control S2 0V<V_{OL}<0.4V 2.7V<V_{OH}<3.3V Current source: 50uA max	Control of the RF part

Connector (Att/T): SMA female

Pin	Name	Description
Inner	RF-part control: ATT/T 0V<V_{OL}<0.2V 2.7V<V_{OH}<3.3V Current source: 50uA max	Control of the RF part

Connector (Temp): SMA female

Pin	Name	Description
Inner	RF part temperature Analog voltage between 0.4V and 1.75V Current source: 10uA typ	Sense RF-part temperature

4.2.4 Power supply (controller)

Parameter	Specification	Note	Comment
Connector	Mini B-type USB		
Supply voltage range (Controller)	4.75V to 5.25V	1	Per USB2.0 standard
Controller current draw	35 mA typ. 90 mA max.	1	Noise source is not connected.

Parameter	Specification	Note	Comment
RF-part current consumption	0.15mA max from 3.3V supply		Supplied by the controller or user's equipment Does not include the DUT biasing current

Note 1: power supplied through micro-B USB 2.0 receptacle, pin Vbus

4.2.5 Noise Source port (controller)

Parameter	Specification	Note	Comment
Connector	USB-A		
Vbus pin	Voltage: Same as C-IG0160CT power supply voltage in Table 3.2.4 Output current: 50 mA max		Noise-source power supply
D+	Noise source control V_{OL}=0.4Vmax V_{OH}=3.0Vmin		Output from C-IG0160CT controller
D-	Noise source temperature input (0V to 3V) Internal 10k pull up to 3.3V		Input to C-IG0160CT controller
GND	Ground		

4.2.6 Non-RF interface (RF part)

Connector (Vdd): Feedthrough

Pin	Name	Description
Inner	Vdd = 3.3V typ 3.2V<Vdd<3.4V Current draw: 100uA max	Power supply to the RF part Typically supplied by the controller

Connector (S1): Feedthrough

Pin	Name	Description
Inner	RF-part control #1 0V<V_{IL}<0.4V 1.2V<V_{IH}<3.6V Current sink: 1uA max	Typically supplied by the controller

Connector (S2): Feedthrough

Pin	Name	Description
Inner	RF-part control #2 0V<V_{IL}<0.4V 1.2V<V_{IH}<3.6V Current sink: 1uA max	Typically supplied by the controller

Connector (Att/T): Feedthrough

Pin	Name	Description
Inner	RF-part control #3 0V<V_{IL}<0.2V 1.8V<V_{IH}<3.6V Supply current: 1uA typ	Typically supplied by the controller

Connector (Temp): Feedthrough

Pin	Name	Description
Inner	RF-part temperature Analog operating voltage: 0.5V to 1.75V Current sink: 10uA typ	RF-part temperature sensor output

Connector (Bias): SMA female

Pin	Name	Description
Inner	Voltage : 5V max Current : 150mA max Max. Power : 0.75W	Bias for the DUT

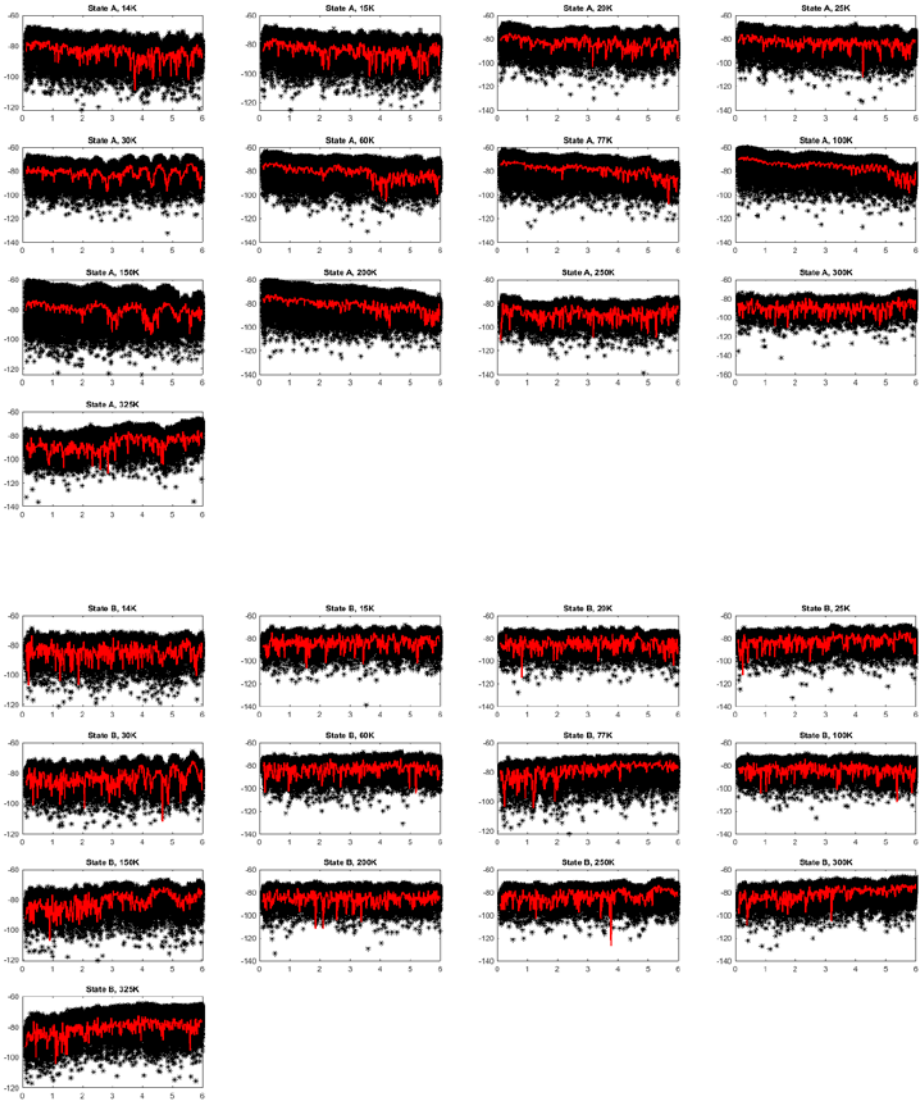
4.2.7 Environmental

Parameter	Specification	Note	Comment
Ambient temperature	<15K to 70ºC		
Operating relative humidity	20% to 80% non-condensing		
Storage relative humidity	20% to 80% non-condensing		
ESD	2 kV HBM		

4.2.8 Regulatory

Parameter	Specification	Ref	Comment
ICES-3	Compliant		
FCC Part 15, Subpart B, Class A	Compliant		

5. Repeatability



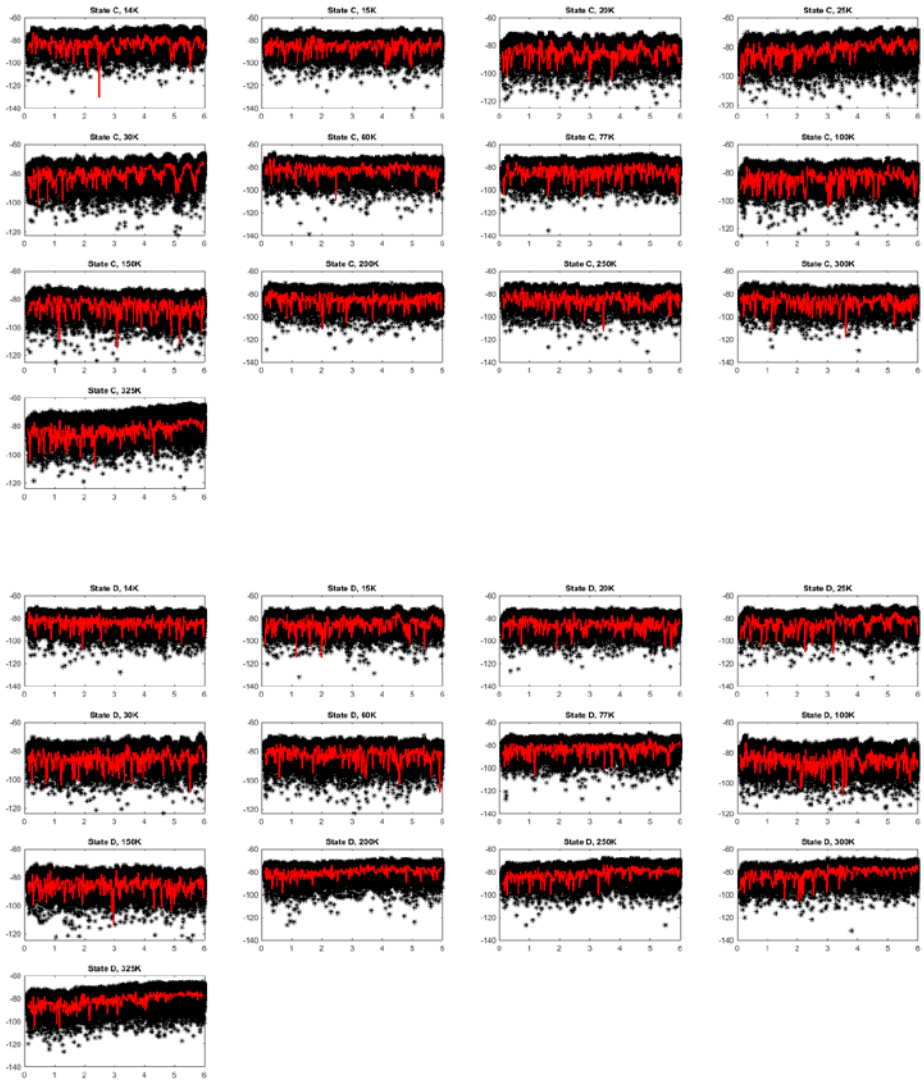


Fig. 2 Typical repeatability of the four IG states (100 trials, network analyzer average is set to 32).

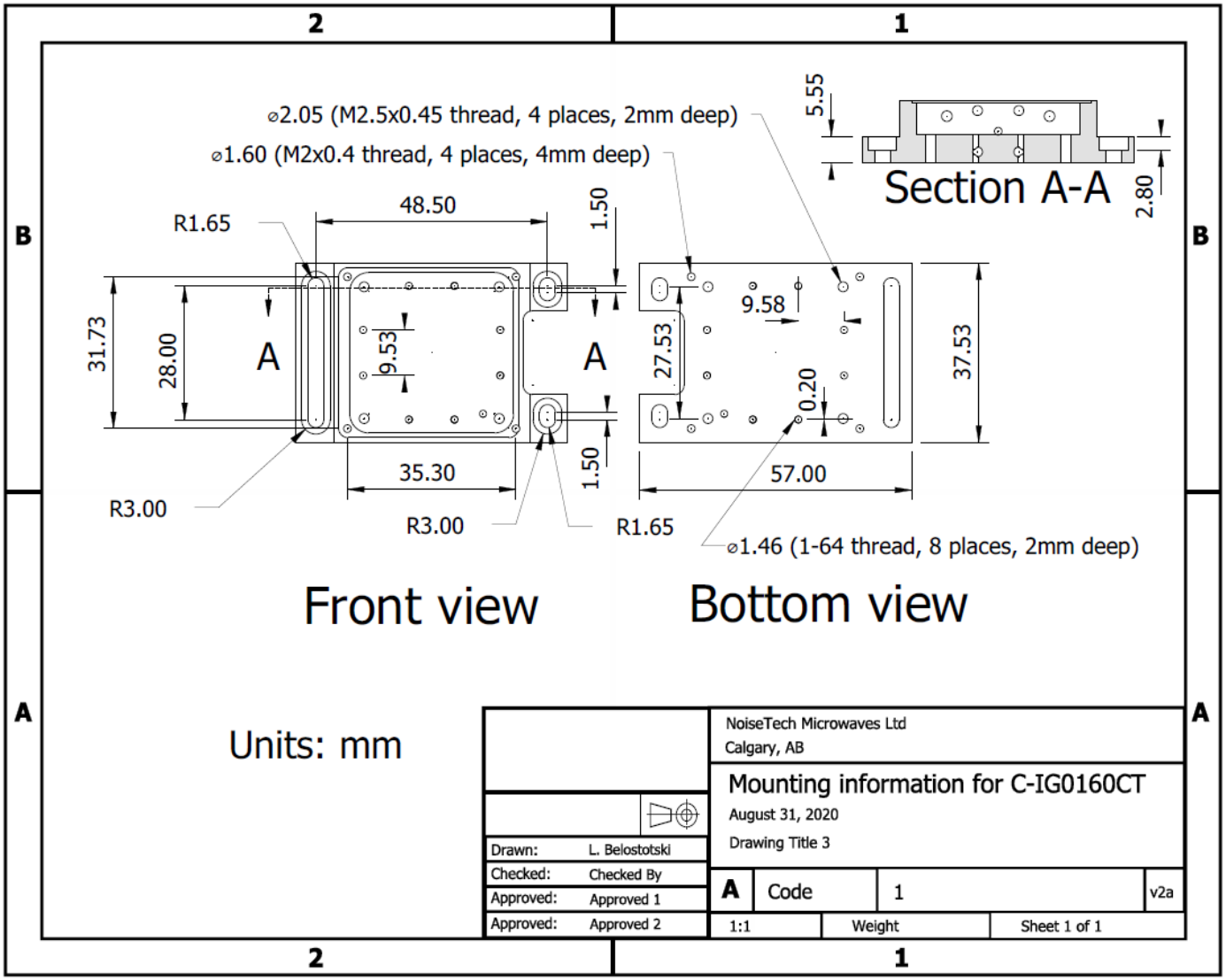


Fig. 3. Mounting information. For details contact NoiseTech Microwaves.

6. Revision notes

Aug 31, 2020: Current sink of the RF part, pin “Connector (Temp)”, changed to 10uA.
Aug 31, 2020: Current source of the Controller, pin “Connector (Temp)”, changed to 10uA.
Aug 31, 2020: Updated width of the RF part.
Aug 31, 2020: Updated mounting drawing.
Aug 31, 2002: Added repeatability plots in Fig. 2.
Aug 31, 2020: Updated repeatability specification.
Nov 14, 2020: Finalized RF specifications
Nov 14, 2020: Updated the photo