NoiseTech Microwaves Ltd.

Product Technical Specifications of Controller and Thermalized Impedance Generators for Cryo Applications

Technical Specification (Version 2a) – September 17, 2022

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2. General

NoiseTech Microwave's 0.1GHz to 18GHz impedance generators are specifically designed for "cold" noise-parameter measurements.

These consists of a controller and an RF part that are interfaced with three low-frequency control lines. Additional interface options include a temperature sensor and a bias-T. The RF part of the impedance generator is placed inside the dewar. Noise-parameter measurement may be accompanied with an external "cold attenuator" or "cold termination" method. Low-frequency impedance generates provide options for built-in either a "cold attenuator" or "cold termination".

The small size and fully electronic design permit noise-parameter measurements of packaged and on-wafer devices. Proprietary wideband impedance generation method allows for quick and precise measurements of noise parameters for 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-IGfllfuuC-aNN-temp
In this part number:

- "fll" specifies the lower-frequency range, e.g. for 2.0GHz specify 20 and for 0.1GHz specify 01.
- "fuu" specifies the upper-frequency range, e.g. for 18.0GHz specify 180 and for 3.5GHz specify 35.
- To specify an optional 15dB cold attenutor, replace "aNN" with "A15". (**This option is only available when the upper frequency range is not higher than 6GHz. For other attenuation values, contact NoiseTech**)
- To specify an optional 50Ω cold attenuator, replace "aNN" with "T" (**This option is only available when the upper frequency range is not higher than 6GHz**
- Replace "temp"with "T" to specify an optional temperature sensor

Verified frequency ranges are: 0.1 to 6GHz, 0.03 to 3.5GHz, and 2 to 18GHz. Contact NoiseTech for other attenuation values and frequency ranges.

Example part numbers: C-IG0160C-A15, C-IG00335C-T-T, C-IG20180C-T

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.		0.03 to 3.5GHz (C-IG00335C)
	20dB typ. 15dB min.		0.1 to 4GHz (C-IG0160C)
	15dB typ. 8dB min.		4 to 6GHz (C-IG0160C)
	15dB typ. 8dB min.		6 to 18GHz (C-IG20180C)
THRU state insertion loss	3dB typ		below 12 GHz
	9.5dB max		12 to 18 GHz (C-IG20180C)
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 100K		

4.2.3 Non-RF interface (Controller)

Connector (Vdd): SMA female

Pin	Name	Description
Inner	Vdd = 3.3V typ 3.15V<Vdd<3.45V Current source: 1mA max	Positive Power supply for the RF part

Connector (Vss): SMA female

Pin	Name	Description
Inner	Vss = -3.3V typ -3.45V<Vss<-3.15V Current source: 1mA max	Negative 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 (Temp): SMA female

Pin	Name	Description
	RF part temperature	

Inner	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	Type-b Mini 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.
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 impedance-generator 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 impedance-generator controller
D-	Noise source temperature input (0V to 3V) Internal 10k pull up to 3.3V		Input to impedance-generator controller
GND	Ground		

4.2.6 Non-RF interface (RF part)

Connector (Vdd): Feedthrough

Pin	Name	Description
Inner	Vdd = 3.3V typ 3.15V<Vdd<3.45V Current draw: 5uA max	Power supply to the RF part Typically supplied by the controller

Connector (Vss): Feedthrough

Pin	Name	Description
Inner	Vss = -3.3V typ -3.45V<Vss<3.15V Current draw: 120uA 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): Feedhrough

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 (Temp): Feedthrough

Pin	Name	Description
Inner	RF-part temperature Analog voltage between 0V and 2.5V Current sink: 10uA typ	RF-part temperature sensor output

Connector (Bias): SMA female

Pin	Name	Description
Inner	Voltage : 10V absolute max (no damage) Current : 150mA max Max. Power : 0.75W	DC Bias for the DUT port

4.2.7 Environmental

Parameter	Specification	Note	Comment
Ambient temperature	15K to 70ºC		<15k performance unspecified
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		

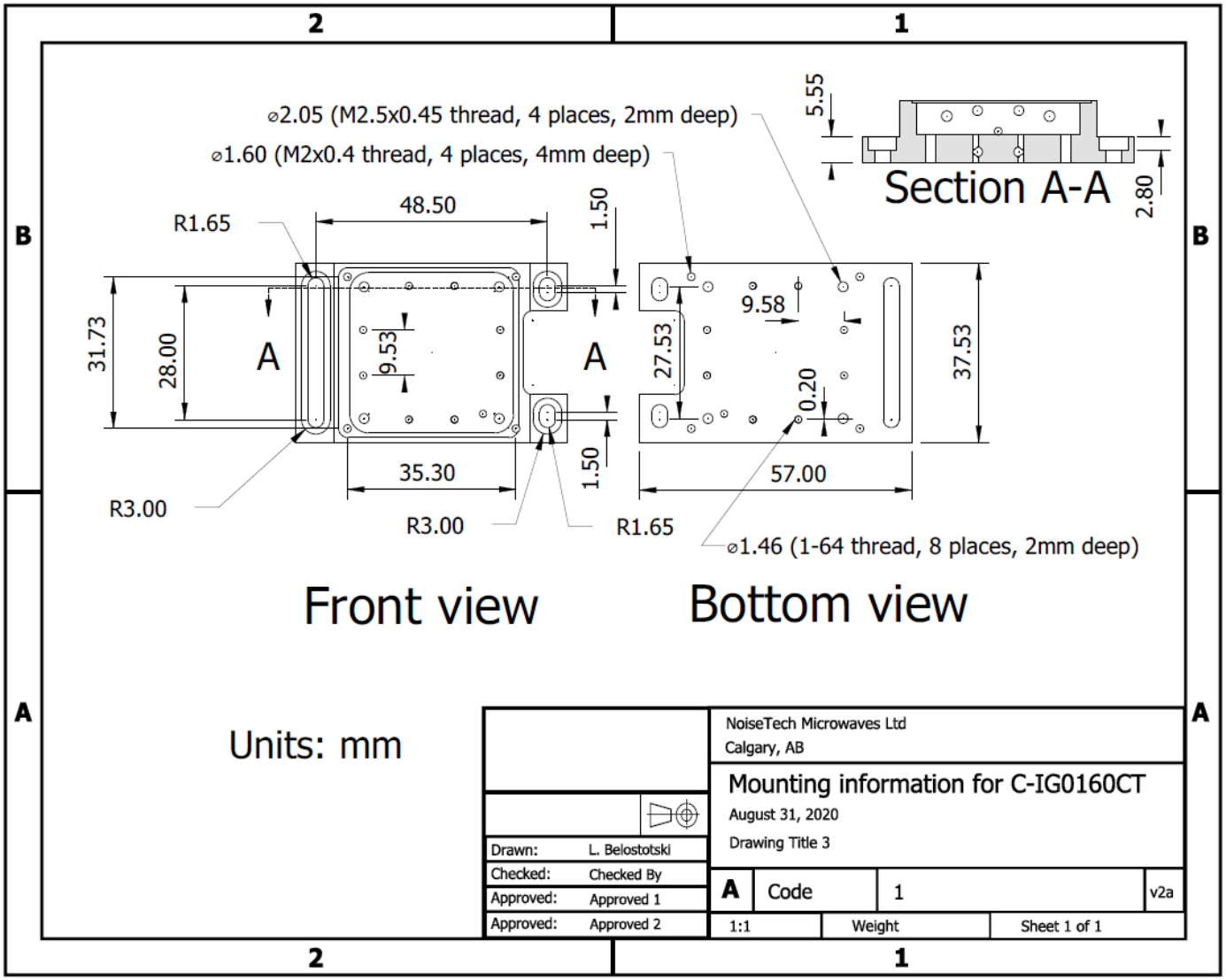

Fig. 2. Mounting information. For details contact NoiseTech Microwaves.

5. Revision notes

Sept 14, 2022: extended frequency range from 12GHz to 18GHz for the high-frequency product.
Sept 14, 2022: adjusted THRU state specifications
Sept 17, 2022: minor editorial changes