

AM3156 - Filter Bank Digitally Tunable 0.4 to 8 GHz Bandpass

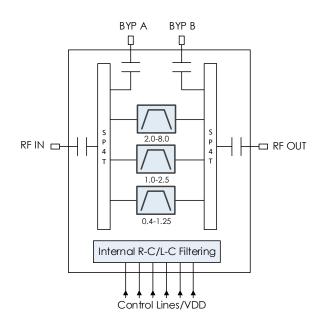
AM3156 is a fully integrated miniature digitally tunable bandpass filter bank covering the 0.4 to 8 GHz frequency range. The device exhibits 3 filter bands each with 256 discrete tune states and a low-loss filter bypass path contained in a 10mm QFN package. AM3156 expands on our AM3152 device by integrating the inductors and DC blocking capacitors and placing it all in one easy to install chip. AM3156 is an excellent frontend for a receiver providing both low insertion loss and valuable flexibility for tuning center frequency and bandwidth. Its small size, weight, and power consumption make it an attractive choice for demanding applications requiring low SWaP components.

FEATURES

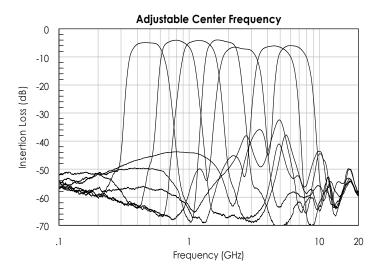
- Digitally Tunable Bandpass Filter
- Integrated Power and Control Line Filtering
- Integrated Inductors and DC Blocks
- 4.5 dB Insertion Loss
- 8 GHz Filter Bypass Path

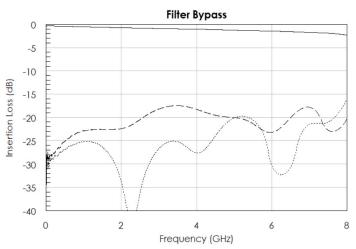
- +3.3V to +5.0V Supply
- +3.3V to +5.0V Control
- 10mm QFN Package
- -40C to +85C Operation

FUNCTIONAL DIAGRAM



CHARACTERISTIC PERFORMANCE





TECHNICAL DATA SHEET

AM3156 - EMI Filter Bank



CONTENTS

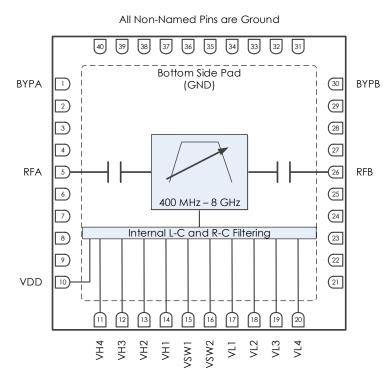
ATURES	
JNCTIONAL DIAGRAM	
HARACTERISTIC PERFORMANCE	
EVISION HISTORY	2
N LAYOUT AND DEFINITIONS	3
PECIFICATIONS	Z
TATE TABLE	6
PICAL PERFORMANCE	6
PICAL APPLICATION	<u>e</u>
COMMENDED COMPONENT LIST (OR EQUIVALENT)	<u>e</u>
/ALUATION PC BOARD	10
LATED PARTS	10
DMPONENT COMPLIANCE INFORMATION	1

REVISION HISTORY

Date	Revision	Notes
June 11, 2021	1	Initial Release
September 3, 2021	1.1	Labels on Evaluation Board Corrected.
September 29, 2021	1.2	Incorrect Note on Pinout, Pin1 Fixed.
June 20, 2024	2	Changed to Mercury branding. No content changes.



PIN LAYOUT AND DEFINITIONS



Pin	Name	Function
1	ВҮРА	Filter Bypass A – Return Pin 30 – 50 Ohms – AC Coupled*
2 - 4	GND	Ground - Common
5	RFA	RFA – 50 Ohms – AC Coupled. Can be Input or Output.
6 – 9	GND	Ground - Common
10	VDD	DC Power Input
11	VH4	Highpass Filter Control Bit 4 (MSB)
12	VH3	Highpass Filter Control Bit 3
13	VH2	Highpass Filter Control Bit 2
14	VH1	Highpass Filter Control Bit 1(LSB)
15	VSW1	Switch Control 1
16	VSW2	Switch Control 2
17	VL1	Lowpass Filter Control Bit 1(LSB)
18	VL2	Lowpass Filter Control Bit 2
19	VL3	Lowpass Filter Control Bit 3
20	VL4	Lowpass Filter Control Bit 4 (MSB)
21 - 25	GND	Ground - Common
26	RFB	RFB - 50 Ohms - AC Coupled. Can be Output or Input.
27 - 29	GND	Ground - Common
30	ВҮРВ	Filter Bypass B – Return Pin 1 – 50 Ohms – AC Coupled. *
31 – 40	GND	Ground - Common
Bottom Pad	GND	Ground - Common

Note: Can be used for external filtering/switching or connected to return pin for a filter bypass path. Connecting BYPA directly to BYPB may reduce filter rejection > 8 GHz. To avoid this, you may place an external LPF filter between the two ports with cutoff frequency <= 8 GHz.



SPECIFICATIONS

Absolute Maximum Ratings

	Minimum	Maximum
Supply Voltage	-0.3 V	+6.0 V
RF Input Power		+27 dBm
Operating Junction Temperature	-40 C	+150 C
Storage Temperature Range	-55 C	+150 C
Voltage at RF / Bypass Ports ¹		+16 WVDC

¹Withstanding voltage of 40V for 5 seconds.

Note: Any device operation beyond the Absolute Maximum Ratings may result in permanent damage to the device. The values listed in this table are extremes and do not imply functional operation of the device at these or any other conditions beyond what is listed under Recommended Operating Conditions. Any part subjected to conditions outside of what is recommended for an extended amount of time may suffer from reliability concerns.

Handling Information

	Minimum	Maximum
Storage Temperature Range (Recommended)	-50 C	+125 C
Moisture Sensitivity Level	MSL 3	



Mercury products are electrostatic sensitive.
Follow safe handling practices to avoid damage.

Recommended Operating Conditions

	Minimum	Typical	Maximum
Supply Voltage	+3.0 V*	+5.0 V	+5.2 V
Operating Case Temperature	-40 C		+85 C
Operating Junction Temperature	-40 C		+125 C

*Note: Operating the AM3156 at VDD levels below +5.0V can cause corner frequencies to shift low by up to 2%. It is recommended to use +5.0V when possible. Control voltage level does not affect filter corner frequencies.

Timing Characteristics

Switching Time	Minimum	Typical	Maximum
Band Switching Speed		130 ns	
Band 1 Tuning Speed		430 ns	
Band 2 Tuning Speed		420 ns	
Band 3 Tuning Speed		970 ns	

Note: Timing characteristics measured from 50% control to 90% RF.



DC Electrical Characteristics

(T = 25 °C unless otherwise specified)

Param	Testing Conditions	Min	Typical	Max
DC Supply Voltage		+3.0 V*	+5.0 V	+5.2 V
DC Supply Current	VDD = +5.0 V		10 mA	
Power Dissipated	VDD = +5.0 V		50 mW	
Logic Level Low		-0.1 V		0.5 V
Logic Level High		+2.0 V		+VDD
Logic Drive Level	VSWx/VHx/VL x = +5.0V	200 μΑ		

*Note: Operating the AM3156 at VDD levels below +5.0V can cause corner frequencies to shift low by up to 2%. It is recommended to use +5.0V when possible. Control voltage level does not affect filter corner frequencies.

RF Performance

(T = 25 °C unless otherwise specified)

Param	Testing Conditions	Min	Typical	Max
Frequency Range	Tunable Filters	0.4 GHz		8 GHz
	Filter Bypass	1 MHz		8 GHz
Insertion Loss	Band 1		-4 dB	
	Band 2		-3.8 dB	
	Band 3		-6 dB	
Return Loss			-12 dB	
Input IP3			+40 dBm	



STATE TABLE

SW2	SW1	Filter Band		
Low	Low	Bypass State		
Low	High	Band 1 - 0.4 to 1.25 GHz		
High	Low	Band 2 - 1.0 to 2.5 GHz		
High	High	Band 3 - 2.0 to 8.0 GHz		

High P	High Pass Filter Typical Cutoff Frequencies (GHz)						
VH4	VH3	VH2	VH1	Band 1	Band 2	Band 3	
Low	Low	Low	Low	0.38	0.93	1.90	
Low	Low	Low	High	0.39	0.95	1.93	
Low	Low	High	Low	0.40	0.96	2.00	
Low	Low	High	High	0.41	0.98	2.02	
Low	High	Low	Low	0.42	1.00	2.11	
Low	High	Low	High	0.43	1.02	2.16	
Low	High	High	Low	0.45	1.05	2.25	
Low	High	High	High	0.47	1.07	2.30	
High	Low	Low	Low	0.50	1.17	2.70	
High	Low	Low	High	0.52	1.20	2.80	
High	Low	High	Low	0.55	1.23	2.95	
High	Low	High	High	0.57	1.26	3.10	
High	High	Low	Low	0.64	1.39	3.50	
High	High	Low	High	0.68	1.43	3.75	
High	High	High	Low	0.75	1.50	4.35	
High	High	High	High	0.84	1.59	4.95	

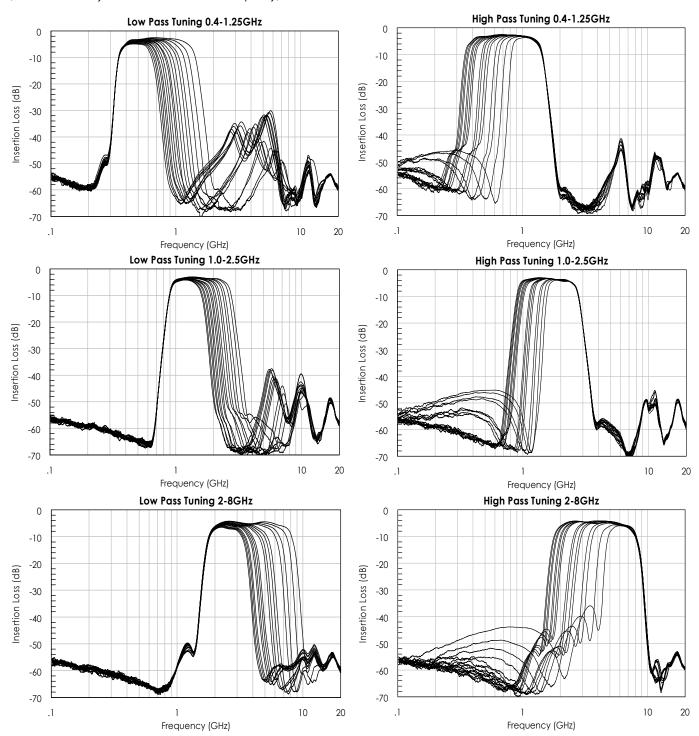
Low P	Low Pass Filter Typical Cutoff Frequencies (GHz)							
VL4	VL3	VL2	VL1	Band 1	Band 2	Band 3		
Low	Low	Low	Low	0.62	1.52	3.22		
Low	Low	Low	High	0.64	1.55	3.27		
Low	Low	High	Low	0.65	1.60	3.33		
Low	Low	High	High	0.67	1.63	3.39		
Low	High	Low	Low	0.69	1.69	3.55		
Low	High	Low	High	0.71	1.73	3.60		
Low	High	High	Low	0.73	1.79	3.70		
Low	High	High	High	0.76	1.84	3.80		
High	Low	Low	Low	0.78	1.92	4.10		
High	Low	Low	High	0.81	1.97	4.25		
High	Low	High	Low	0.85	2.05	4.50		
High	Low	High	High	0.91	2.12	4.75		
High	High	Low	Low	0.95	2.23	5.55		
High	High	Low	High	1.04	2.32	6.00		
High	High	High	Low	1.15	2.47	6.75		
High	High	High	High	1.30	2.60	8.0		

 $\textbf{Note:} \ \textbf{State Table cutoff frequencies measured with VDD} = 5.0 \text{V. Cutoffs are -3dB relative to Fc.}$



TYPICAL PERFORMANCE

(VDD = +5.0V. Only some states shown for simplicity)

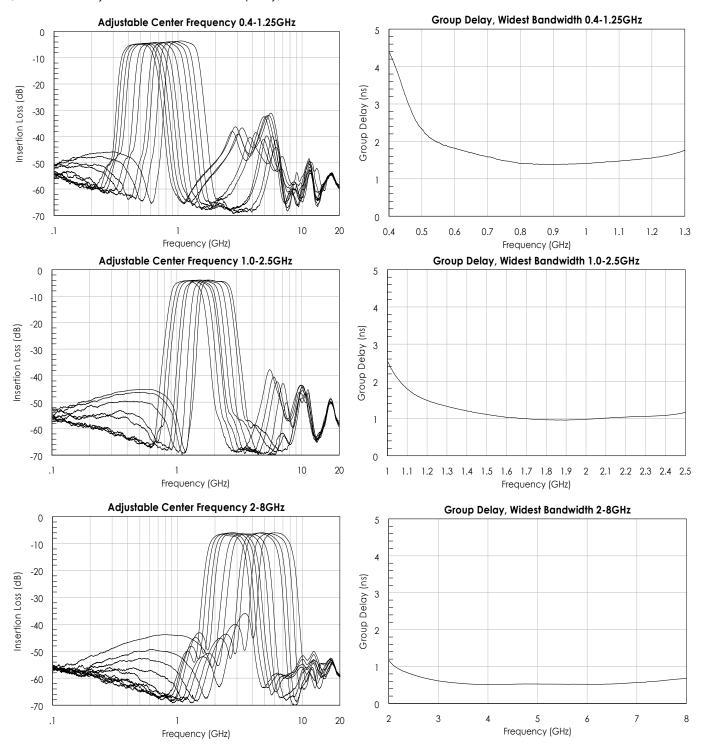


^{*}Typical values shown for lowest tuned frequency (control bits 0000) or highest tuned frequency (control bits 1111).



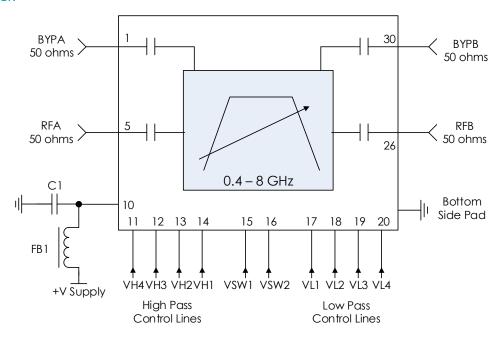
TYPICAL PERFORMANCE (CONTINUED)

(VDD = +5.0V. Only some states shown for simplicity)





TYPICAL APPLICATION



RECOMMENDED COMPONENT LIST (OR EQUIVALENT)

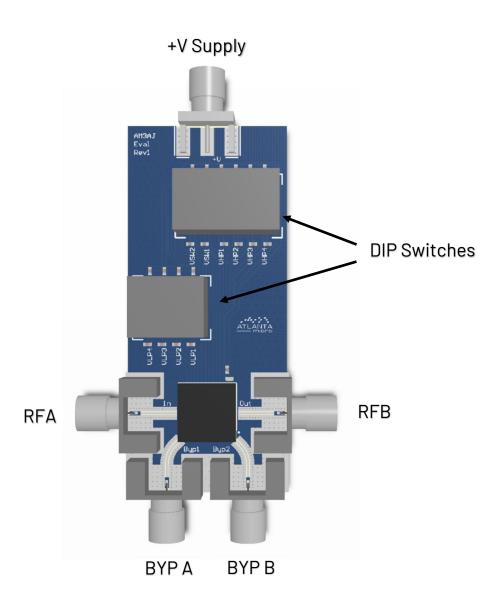
Part	Value	Part Number	Manufacturer
C1	0.1 µF	C1005X7R1H104K050BB	TDK
FB1		MMZ1005A222E	TDK

Notes:

- 1. VDD and Control Lines filtered internally providing high frequency isolation.
- 2. It is recommended to add C1 and FB1 for further power line clean up.
- 3. No RC filtering required on pins 11 through 20. Switching and tuning speed reported in "Timing characteristics" section are inclusive of these internal filters.
- ${\bf 4.} \quad {\sf RFA, RFB, BYPA, and BYPB are AC \ coupled, no \ external \ DC \ blocking \ capacitors \ required.}$
- 5. If top layer dielectric is < 6 mils then ground cutouts should be added under pins 1, 5, 26, and 30 to minimize parasitic capacitance. A cutout of 0.6mm x 1mm is recommended.



EVALUATION PC BOARD



RELATED PARTS

Part Number		Description
AM3152	0.4 GHz to 8 GHz	Digitally Tunable Bandpass Filter
AM3090	100 MHz to 450 MHz	Digitally Tunable Bandpass Filter
AM3150	30 MHz to 550 MHz	Digitally Tunable Low Pass Filter
AM3151	20 GHz to 360 MHz	Digitally Tunable High Pass Filter



COMPONENT COMPLIANCE INFORMATION

RoHS: Mercury Systems, Inc. hereby certifies that all products comply with the EC Directive 2011/65/EC on the Restriction of Hazardous Substances, commonly known as EU-RoHS 6 and 10. All products supplied by Mercury shall be compliant with the European Directive 2011/65/EC based on the following substance list.

Substance List	Allowable Maximum Concentration
Lead (Pb)	<1000 PPM (0.1% by weight)
Mercury (Hg)	<1000 PPM (0.1% by weight)
Cadmium (Cd)	<75 PPM (0.0075% by weight)
Hexavalent Chromium (CrVI)	<1000 PPM (0.1% by weight)
Polybrominated Biphenyls (PBB)	<1000 PPM (0.1% by weight)
Polybrominated Diphenyl ethers (PBDE)	<1000 PPM (0.1% by weight)
Decabromodiphenyl Deca BDE	<1000 PPM (0.1% by weight)
Bis (2-ethylheyl) Phthalate (DEHP)	<1000 PPM (0.1% by weight)
Butyl Benzyl Phthalate (BBP)	<1000 PPM (0.1% by weight)
Dibutyl Phthalate (DBP)	<1000 PPM (0.1% by weight)
Diisobutyl Phthalate (DIBP)	<1000 PPM (0.1% by weight)

REACH: Mercury Systems, Inc. neither uses nor intentionally adds any of the substances considered to be a Substance of Very High Concern (SVHC) as defined by the EU Regulation (EC) No. 1907–2006 on Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH).

Conflict Materials: Mercury does not knowingly use materials that are sourced from the Democratic Republic of Congo (DRC) or any other known conflict regions. Mercury's supply chain is comprised of sources that are both environmentally and socially responsible. We periodically review this requirement with our vendors to ensure continued compliance.

Mercury takes its responsibility as a global partner seriously and will use due diligence within our supply chain to ensure all standards are met to the best of our knowledge.

mercury

Corporate Headquarters

50 Minuteman Road Andover, MA 01810 USA

- +1 978.967.1401 tel
- +1866.627.6951 tel
- +1 978.256.3599 fax

International Headquarters Mercury International

Avenue Eugène-Lance, 38 PO Box 584 CH-1212 Grand-Lancy 1 Geneva, Switzerland

+41 22 884 5100 tel

Learn more

Visit: mrcy.com

For pricing details, contact: MMICsales@mrcy.com
For technical details, contact: MMICsupport@mrcy.com











The Mercury Systems logo is a registered trademark of Mercury Systems, Inc. Other marks used herein may be trademarks or registered trademarks of their respective holders. Mercury products identified in this document conform with the specifications and standards described herein. Conformance to any such standards is based solely on Mercury's internal processes and methods. The information contained in this document is subject to change at any time without notice.



© 2024 Mercury Systems, Inc. 2-0-2024-06-20-DS-AM3156