

MILITARY COTS EMI FILTER

-500V to +500V
Continuous Input

9A
Output Current

106mΩ @ 100°C
Max. DC Resistance

>70dB @ 250kHz
Differential Attenuation

FULL POWER OPERATION: -55°C to +100°C

The Mil-COTS series of EMI filters brings SynQor's field proven technology and manufacturing expertise to the military and aerospace industry. SynQor's innovative packaging approach ensures survivability in the most hostile environments. Compatible with the industry standard format, these filters have high differential-mode and common-mode attenuation, low DC resistance, and a stabilizing bulk capacitor resistor. They follow conservative component derating guidelines and they are designed and manufactured to the highest standards.

MilCOTS™



Designed and Manufactured in the USA

Operational Features

- 9 amps output current
- Very low DC resistance
- > 70 dB differential-mode attenuation at 250kHz
- > 50 dB common-mode attenuation at 250kHz
- Stabilizing bulk capacitor and damping resistor included
- All capacitors are X7R multi-layer ceramic

Mechanical Features

- Size: 2.49" x 2.39" x 0.51" (63.1 x 60.6 x 13.0 mm)
- Total weight: 5.3 oz. (151 g)
- Flanged baseplate version available

Safety Features

- 2500V, input-to-case isolation
- Certified 60950-1 requirement for basic insulation (see Standards and Qualifications page)

In-Line Manufacturing Process

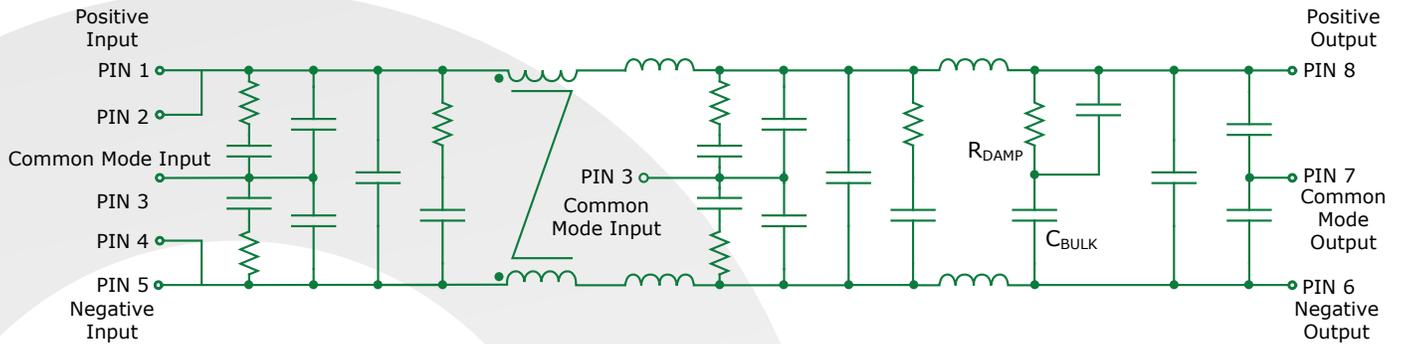
- AS9100 and ISO 9001 Certified Facility
- Full component traceability

Screening Qualifications

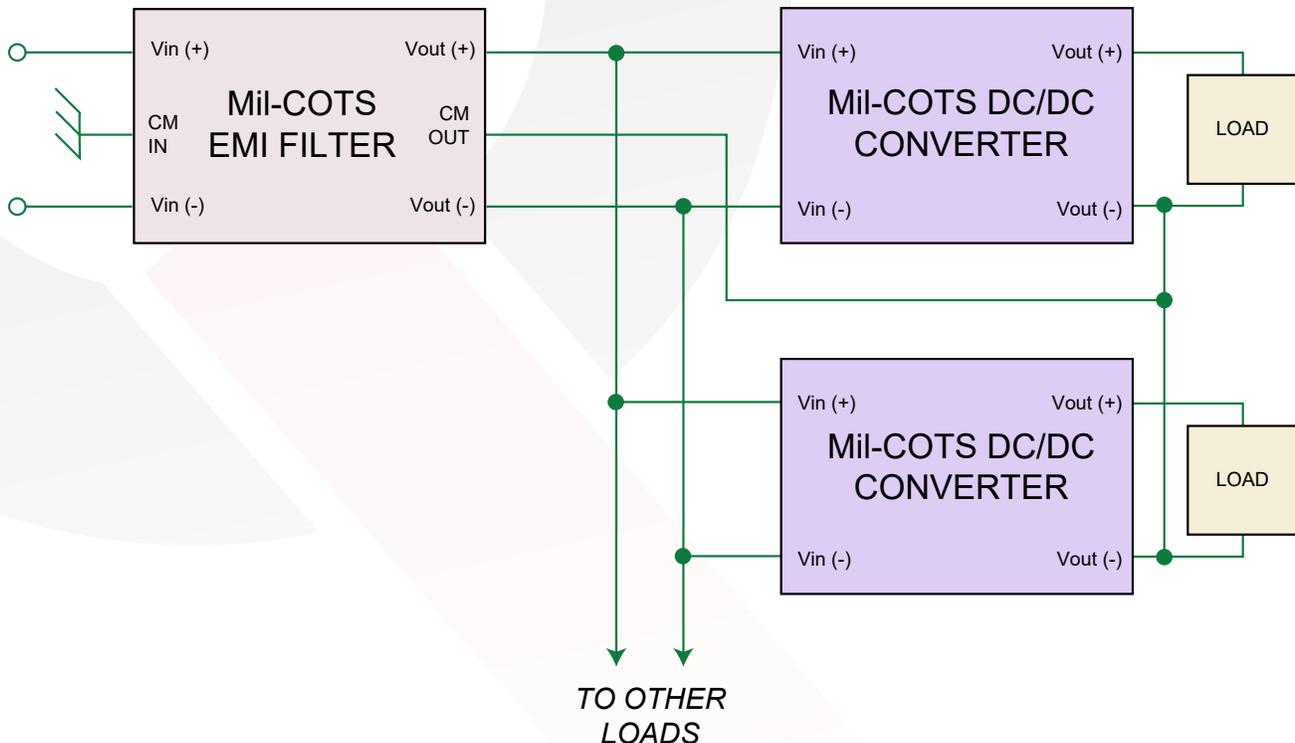
- Qualified to MIL-STD-810
- Available with S-Grade or M-Grade screening
- Pre-cap inspection per IPC-610, Class III
- Temperature cycling per MIL-STD-883, Method 1010, Condition B, 10 cycles
- Burn-In at 100°C baseplate temperature
- Final visual inspection per MIL-STD-883, Method 2009



Fundamental Circuit Diagram



Typical Connection Diagram





MCOTS-F-270-P-HT
Current: 9A

MCOTS-F-270-P-HT ELECTRICAL CHARACTERISTICS

Tb = 25 °C, Vin=270V DC ±5%, Iout=9A unless otherwise noted; full operating temperature range is -55 °C to +100 °C baseplate temperature. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Continuous	-500		500	V	
Transient (≤ 1 s)	-630		630	V	
Isolation Voltage	-2500		2500	V	Input/Output to Common-mode pins
Output Current			9	A	Vin = 155V
Operating Case Temperature	-55		100	°C	Baseplate Temperature
Storage Case Temperature	-65		135	°C	
RECOMMENDED OPERATING CONDITIONS					
Input Voltage					
Continuous	-500		500	V	Operating
Transient (1 s, Rs* = 0 Ω)	-630		630	V	* Rs = Source Impedance
Output Current (continuous)	-9		9	A	
ELECTRICAL CHARACTERISTICS					
Output Voltage (continuous)	Vout = Vin - (Iin x Rdc)			V	
DC Resistance (Rdc)					
Tcase = 25°C			83	mΩ	
Tcase = 100°C			106	mΩ	
Power Dissipation (9A output current)					Vin = 155V
Tcase = 25°C			7	W	
Tcase = 100°C			9	W	
Total Differential-Mode Capacitance		2		μF	Measured across output pins
Total Common-Mode Capacitance		0.2		μF	Measured between any pin to case
Bulk Capacitor		6		μF	Measured without a DC bias
Damping Resistor		1.2		Ω	
Noise Attenuation					See Figure A
Isolation Resistance (any pin to case)	30			MΩ	
RELIABILITY CHARACTERISTICS					
Calculated MTBF (MIL-STD-217F2)					
GB @ Tcase = 70°C		108		10 ⁶ Hrs.	
GM @ Tcase = 70°C		6.2		10 ⁶ Hrs.	
WEIGHT CHARACTERISTICS					
Device Weight		151		g	

Electrical Characteristics Notes

1. Only the M grade products are tested at three temperatures. The S grade products are tested at one temperature. Please refer to the Mil-COTS Screening table for details.

* Rs = Source Impedance



Basic Operation and Features

This module is a multi-stage differential-mode and common-mode passive EMI filter designed to interface a power source with one or more Mil-COTS DC-DC converters (or other loads that create EMI). Each stage of this filter is well damped to avoid resonances and oscillations, and only X7R multi-layer ceramic capacitors are used. This Mil-COTS EMI filter includes a large bulk capacitor with a series damping resistor to correct for the unstabilizing effect of a converter's negative input resistance. A white paper discussing this negative input resistance and the need for corrective damping can be found on the SynQor website (see Input System Instability application note).

A typical application would place the Mil-COTS filter close to the input of the DC-DC converter. The input-side common-mode pin would be connected to the chassis ground that is common with the system input line filter or other earthed point used for EMI measurement. The output-side common-mode pin would be connected to the output ground or plane of the power converters with as low inductance a path as possible. There are no connections to the metal baseplate, which may also be connected to the chassis ground if desired.

Do not connect the outputs of multiple Mil-COTS filters in parallel. Connecting filters in this manner may result in slightly unequal currents to flow in the positive and return paths of each filter. These unequal currents may cause the internal common-mode chokes to saturate and thus cause degraded common-mode rejection performance.

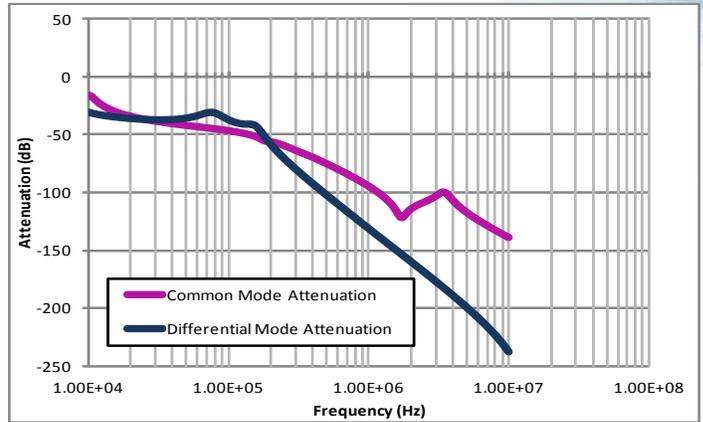


Figure A: Simulation of calculated common-mode and differential-mode current attenuation. The curves plot the ratio of noise current through a 50Ω LISN sensing resistor to a noise source at the filter output (see Figures B and C).

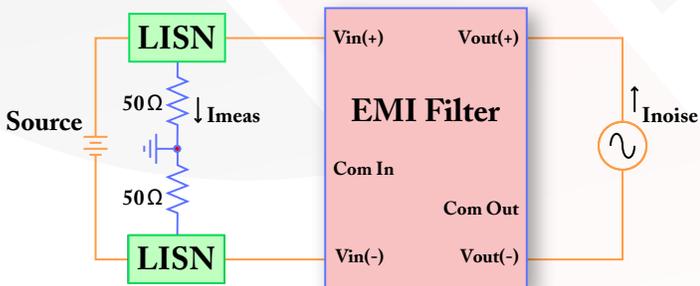


Figure B: Differential-Mode Current Attenuation, I_{meas} / I_{noise}

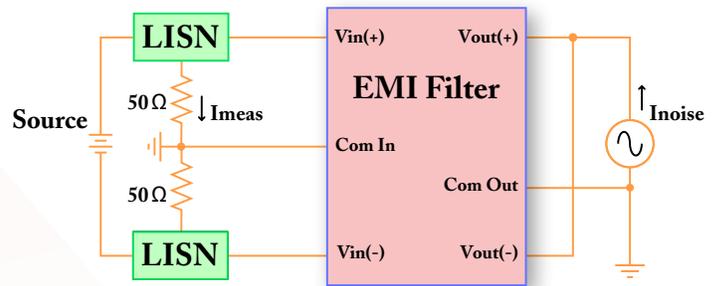
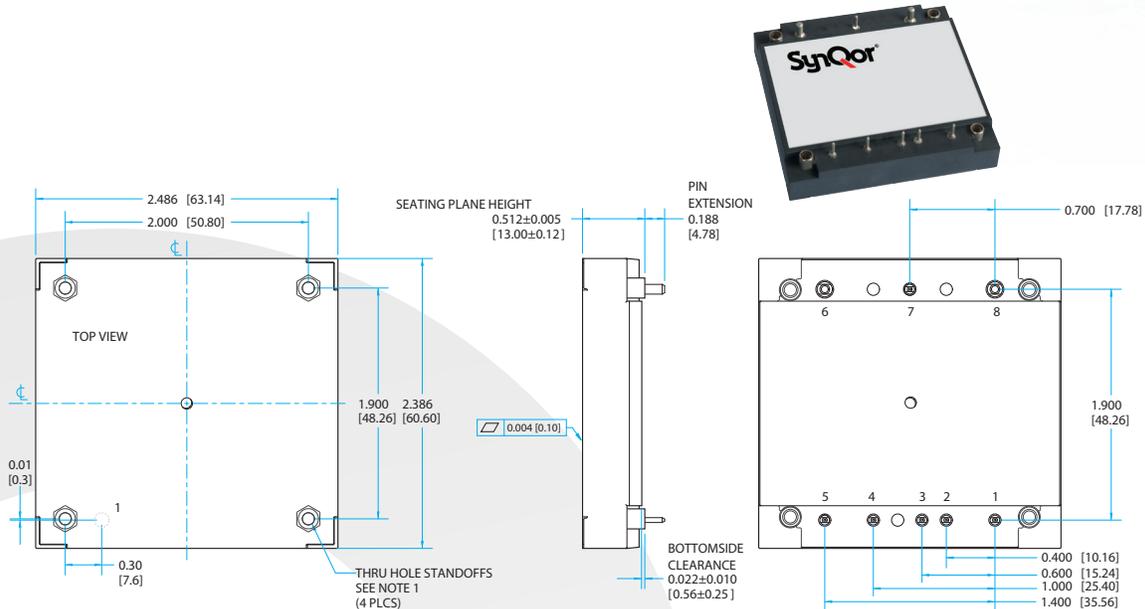


Figure C: Common-Mode Current Attenuation, I_{meas} / I_{noise}

Encased Mechanical Diagram



NOTES

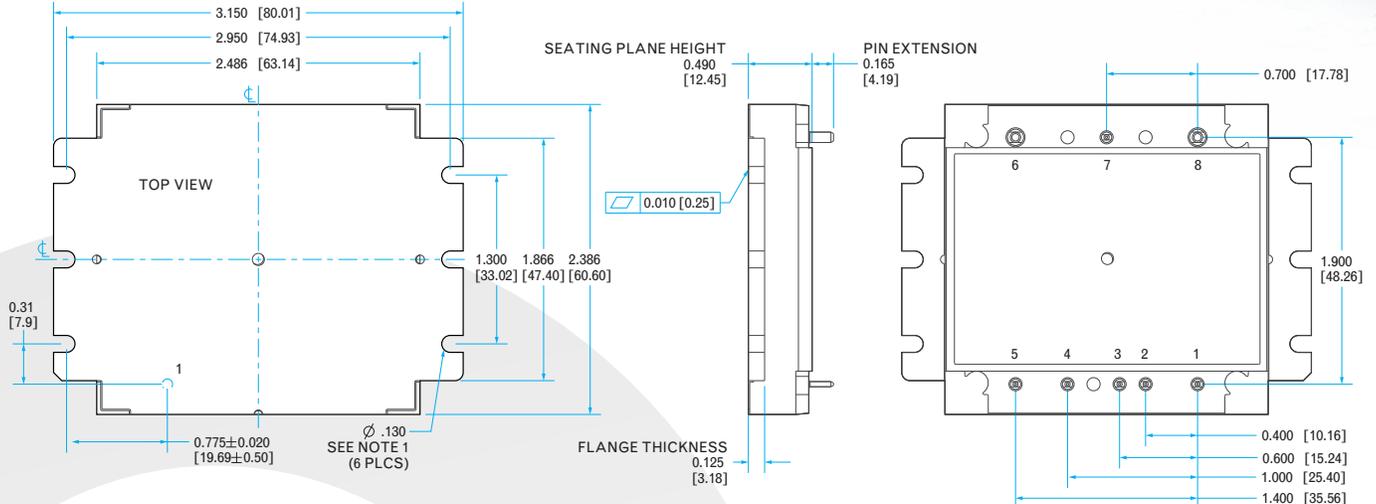
- 1) Applied torque per M3 or 4-40 screw should not exceed 6in-lb (0.7 Nm).
- 2) Baseplate flatness tolerance is 0.004" (.10mm) TIR for surface.
- 3) Pins 1-5 and 7, are 0.040" (1.02mm) diameter, with 0.080" (2.03mm) diameter standoff shoulders.
- 4) Pins 6 and 8 are 0.080" (2.03 mm) diameter with 0.125" (3.18 mm) diameter standoff shoulders.
- 5) All Pins: Material – Copper Alloy; Finish – Matte Tin over Nickel plate
- 6) Undimensioned components are shown for visual reference only.
- 7) Weight: 5.3 oz. (151 g) typical
- 8) Threaded or Non-Threaded options available
- 9) All dimensions in inches (mm)
 Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm)
 x.xxx +/-0.010 in. (x.xx +/-0.25mm)
 Workmanship: Meets or exceeds IPC-A610 Class II

PIN DESIGNATIONS

Pin	Name	Function
1	+Vin	Positive input voltage
2	+Vin	Positive input voltage
3	COM IN	Common mode input
4	IN RTN	Input return
5	IN RTN	Input return
6	OUT RTN	Output return
7	COM OUT	Common mode output
8	+Vout	Positive output voltage



Flanged Encased Mechanical Diagram



NOTES

- 1) Applied torque per M3 or 4-40 screw should not exceed 6in-lb (0.7 Nm).
- 2) Baseplate flatness tolerance is 0.010" (.2mm) TIR for surface.
- 3) Pins 1-5 and 7, are 0.040" (1.02mm) diameter, with 0.080" (2.03mm) diameter standoff shoulders.
- 4) Pins 6 and 8 are 0.080" (2.03 mm) diameter with 0.125" (3.18 mm) diameter standoff shoulders.
- 5) All Pins: Material – Copper Alloy; Finish – Matte Tin over Nickel plate
- 6) Undimensioned components are shown for visual reference only.
- 7) Weight: 5.5 oz. (157 g) typical
- 8) All dimensions in inches (mm)
Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm)
x.xxx +/-0.010 in. (x.xx +/-0.25mm)
- 9) Workmanship: Meets or exceeds IPC-A610 Class II

PIN DESIGNATIONS

Pin	Name	Function
1	+Vin	Positive input voltage
2	+Vin	Positive input voltage
3	COM IN	Common mode input
4	IN RTN	Input return
5	IN RTN	Input return
6	OUT RTN	Output return
7	COM OUT	Common mode output
8	+Vout	Positive output voltage



Mil-COTS Qualification

Test Name	Details	# Tested (# Failed)	Consistent with MIL-STD-883F Method
Life Testing	Visual, mechanical and electrical testing before, during and after 1000 hour burn-in @ 90% load	10 (0)	Method 1005.8
Shock-Vibration	Visual, mechanical and electrical testing before, during and after shock and vibration tests	5 (0)	MIL-STD-202, Methods 201A & 213B
Humidity	+85°C, 95% RH, 1000 hours, 2 minutes on / 6 hours off	5 (0)	Method 1004.7
Temperature Cycling	500 cycles of -55°C to +100°C (30 minute dwell at each temperature)	10 (0)	Method 1010.8 Condition A
Solderability	15 pins	15 (0)	Method 2003
Altitude	70,000 feet (21 km), see Note	2 (0)	

Note: A conductive cooling design is generally needed for high altitude applications because of naturally poor convective cooling at rare atmospheres.

Mil-COTS Converter and Filter Screening

Screening	Process Description	S-Grade	M-Grade
Baseplate Operating Temperature		-55 °C to +100 °C	-55 °C to +100 °C
Storage Temperature		-65 °C to +135 °C	-65 °C to +135 °C
Pre-Cap Inspection	IPC-A-610, Class III	•	•
Temperature Cycling	MIL-STD-883F, Method 1010, Condition B, 10 Cycles		•
Burn-In	100 °C Baseplate	12 Hours	96 Hours
Final Electrical Test	100%	25 °C	-55 °C, +25 °C, +100 °C
Final Visual Inspection	MIL-STD-883F, Method 2009	•	•

STANDARDS COMPLIANCE

Parameter **Notes & Conditions**

STANDARDS COMPLIANCE	
UL 60950-1:2007/A2:2014	Basic Insulation
CAN/CSA C22.2 No. 60950-1:2007/A2:2014	
EN 60950-1:2006/A2:2013	

Note: An external input fuse must always be used to meet these safety requirements. Contact SynQor for official safety certificates on new releases or download from the SynQor website.



MCOTS-F-270-P-HT
Current: 9A

Mil-COTS MIL-STD-810G Qualification Testing

MIL-STD-810G Test	Method	Description
Fungus	508.6	Table 508.6-I
Altitude	500.5 - Procedure I	Storage: 70,000 ft / 2 hr duration
	500.5 - Procedure II	Operating: 70,000 ft / 2 hr duration; Ambient Temperature
Rapid Decompression	500.5 - Procedure III	Storage: 8,000 ft to 40,000 ft
Acceleration	513.6 - Procedure II	Operating: 15 g
Salt Fog	509.5	Storage
High Temperature	501.5 - Procedure I	Storage: 135 °C / 3 hrs
	501.5 - Procedure II	Operating: 100 °C / 3 hrs
Low Temperature	502.5 - Procedure I	Storage: -65 °C / 4 hrs
	502.5 - Procedure II	Operating: -55 °C / 3 hrs
Temperature Shock	503.5 - Procedure I - C	Storage: -65 °C to 135 °C; 12 cycles
Rain	506.5 - Procedure I	Wind Blown Rain
Immersion	512.5 - Procedure I	Non-Operating
Humidity	507.5 - Procedure II	Aggravated cycle @ 95% RH (Figure 507.5-7 aggravated temp - humidity cycle, 15 cycles)
Random Vibration	514.6 - Procedure I	10 - 2000 Hz, PSD level of 1.5 g ² /Hz (54.6 g _{rms}), duration = 1 hr/axis
Shock	516.6 - Procedure I	20 g peak, 11 ms, Functional Shock (Operating no load) (saw tooth)
	516.6 - Procedure VI	Bench Handling Shock
Sinusoidal vibration	514.6 - Category 14	Rotary wing aircraft - helicopter, 4 hrs/axis, 20 g (sine sweep from 10 - 500 Hz)
Sand and Dust	510.5 - Procedure I	Blowing Dust
	510.5 - Procedure II	Blowing Sand



MCOTS-F-270-P-HT
Current: 9A

Ordering Information

Example MCOTS-F-270-P-HT-N-S

Family	Product	Input Voltage	Filter Type	Package	Thermal Design	Screening Level
MCOTS	F: Filter	270: -500V to +500V	P: Passive	HT: Half Brick	N: Normal Threaded D: Normal Non-Threaded F: Flanged	S: S-Grade M: M-Grade

Not all combinations make valid part numbers, please contact SynQor for availability. See the Product Summary web page for more options.

Application Notes

A variety of application notes and technical white papers can be downloaded in pdf format from our website.

Contact SynQor for further information and to order:

Phone: 978-849-0600 **Toll Free:** 888-567-9596 **Fax:** 978-849-0602

E-mail: power@synqor.com **Web:** www.synqor.com

Address: 155 Swanson Road, Boxborough, MA 01719 USA

Warranty

SynQor offers a two (2) year limited warranty. Complete warranty information is listed on our website or is available upon request from SynQor.

PATENTS

SynQor holds numerous U.S. patents, one or more of which apply to most of its power conversion products. Any that apply to the product(s) listed in this document are identified by markings on the product(s) or on internal components of the product(s) in accordance with U.S. patent laws. SynQor's patents include the following:

6,896,526	6,927,987	7,050,309	7,085,146
7,765,687	7,787,261	8,149,597	8,644,027