CVGEN21X™

LOW FREQUENCY FUNCTION GENERATOR

OPERATIONS & MAINTENANCE MANUAL

Version *<1.0>*

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VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason & Signature
1.0	*Virashree Patel, Song Jiazhang, Tianyu Lin, Thanh Orr, Jesus Sanchez*	*12/12/13*	Dr. Hageman	*12/12/13*	

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1 INTRODUCTION

1.1 MISSION STATEMENT

We are proud of our diverse workforce which allows us to achieve business excellence by delivering a quality product to our customers. We are dedicated to developing innovative technologies for our customers' needs.

1.2 ABOUT CV ELECTRONICS

1.3 OUR TEAM

2 SYSTEM DESCRIPTION

2.1 KEY FEATURES

The CVGEN21X™Low Frequency Generator is a multi-waveform generator, which can provide stable, high-precision and low distortion sine, square, and triangle signals. Its features and easiness to operate together with its inexpensiveness makes the CVGN21X™an affordable and versatile solution for your business.

2.2 SPECIFICATIONS/LIMITS

- *3 Standard Waveforms: sine, square, and triangle signal.*
- *Precise Waveform with Adjustable Amplitude, Frequency and DC Offset*
    - *Supports frequency from 10 Hz – 1 kHz*
    - *Voltage amplitude 0-80Vpp*
    - *DC Offset ±60V*
- *Low Distortion/Noise*
- *Durable Protective Aluminum Case*
- *Powered by two (2) 9V Alkaline Batteries*
- *Portable and Light Weighted*
- *Easy-to-use User Interface*
- *Can be used anywhere and anytime because of inbuilt power supply.*

3 QUICK START

3.1 GENERAL INSPECTION

When you get a new CVGN21X™ Low Frequency Generator you are suggested to take the following steps to inspect the instrument:

1) *Inspect the shipping container for damage.*
    a. *If there is any damage in the packing or foam, keep them intact until the instrument has pass the electric and mechanical testing.*
2) *Inspect the instrument*

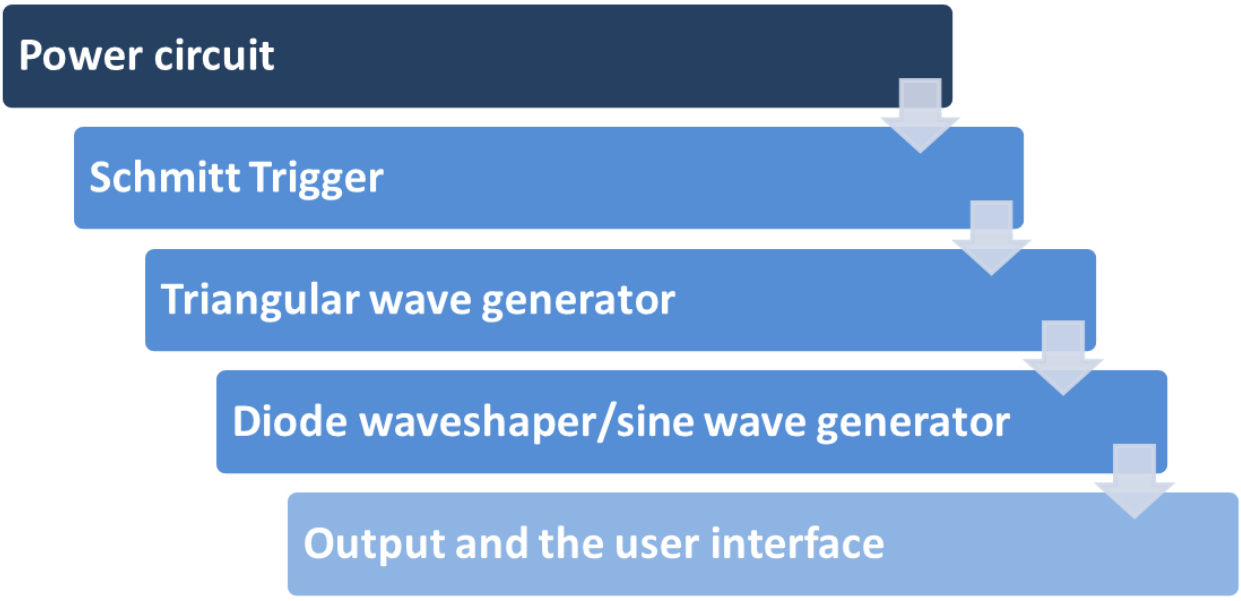
a. *In case any mechanical damage o defect, o if the instrument does not operate property or pass performance test, notify your CV Electronics Sales Representative.*

3.2 BLOCK DIAGRAM

This section will make brief introduction and description for the operation and function of the Top, Right/Left side panel.

The CVGEN21X mainly comprises of a triangular wave generator and a diode wave shaper circuits. The triangular wave generator generates a square wave using a Schmitt trigger which is later fed to an integrator that gives a triangular wave out of it. This triangular wave is then works as an input to the diode wave shaper that gives a sinusoidal wave.

Below is the simple block diagram that explains the working of our device:



3.3 USER INTERFACE

The User interface includes the top panel, right panel and the left panel. CVGEN21X is easy to carry and light weighted. It doesn't need any external power supply. You can use it whenever and wherever you want.

3.2.1 TOP PANEL

The top panel has the following features:

- *A switch at the top for the easy on/off control*
- *Three different knobs to vary the frequency, amplitude and dc offset at the top*

3.2.2 RIGHT PANEL

The right panel has the following features:

Knob to switch among the square wave, triangular wave and the sine wave output which can be obtained from the Output 1 on the Left panel.

3.2.3 LEFT PANEL

The left panel has the following features:

- *Two probe connectors for the output.*
- *Output 1 refers to the right panel. You can get different waveforms by using the knob on the left panel from the output 1. You can also vary the amplitude , frequency and the DC offset of the signal using the knobs at the top panel.*
- *Output 2 gives the standard square wave output of 5Vpp for the different frequencies*.
- *Two variable outputs – square wave and sine wave-on the left to connect to display*

3.4 SET UP A WAVEFORM

4 SPECIFICS

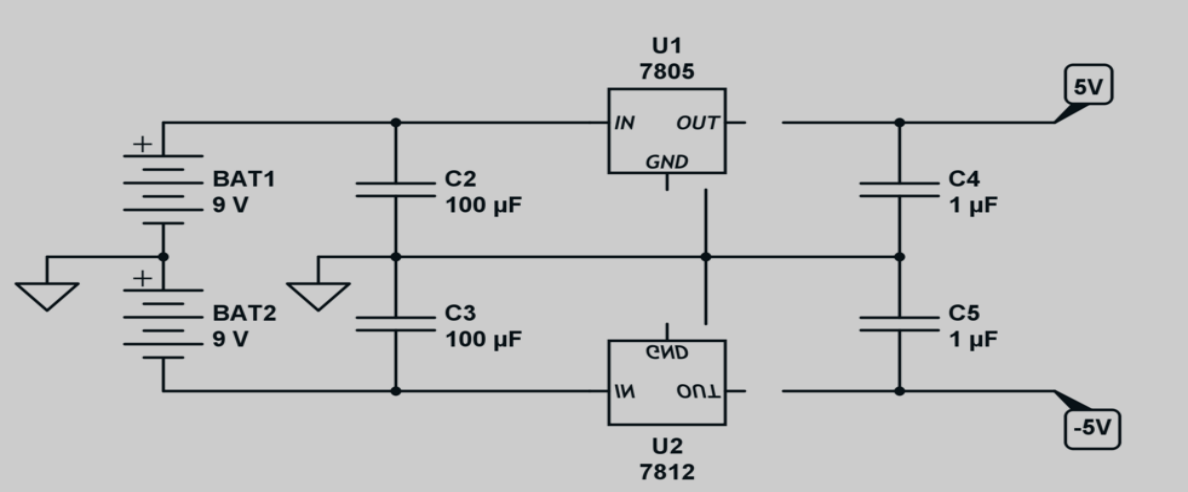
4.1 SCHEMATICS

The following will include all of the schematics involved for the design.

4.1.1 POWER CIRCUIT

The CVGEN21X is powered by two alkaline 9 volt batteries. It has two voltage regulators U7805 and U7812.

Here is the schematic of the power circuit.

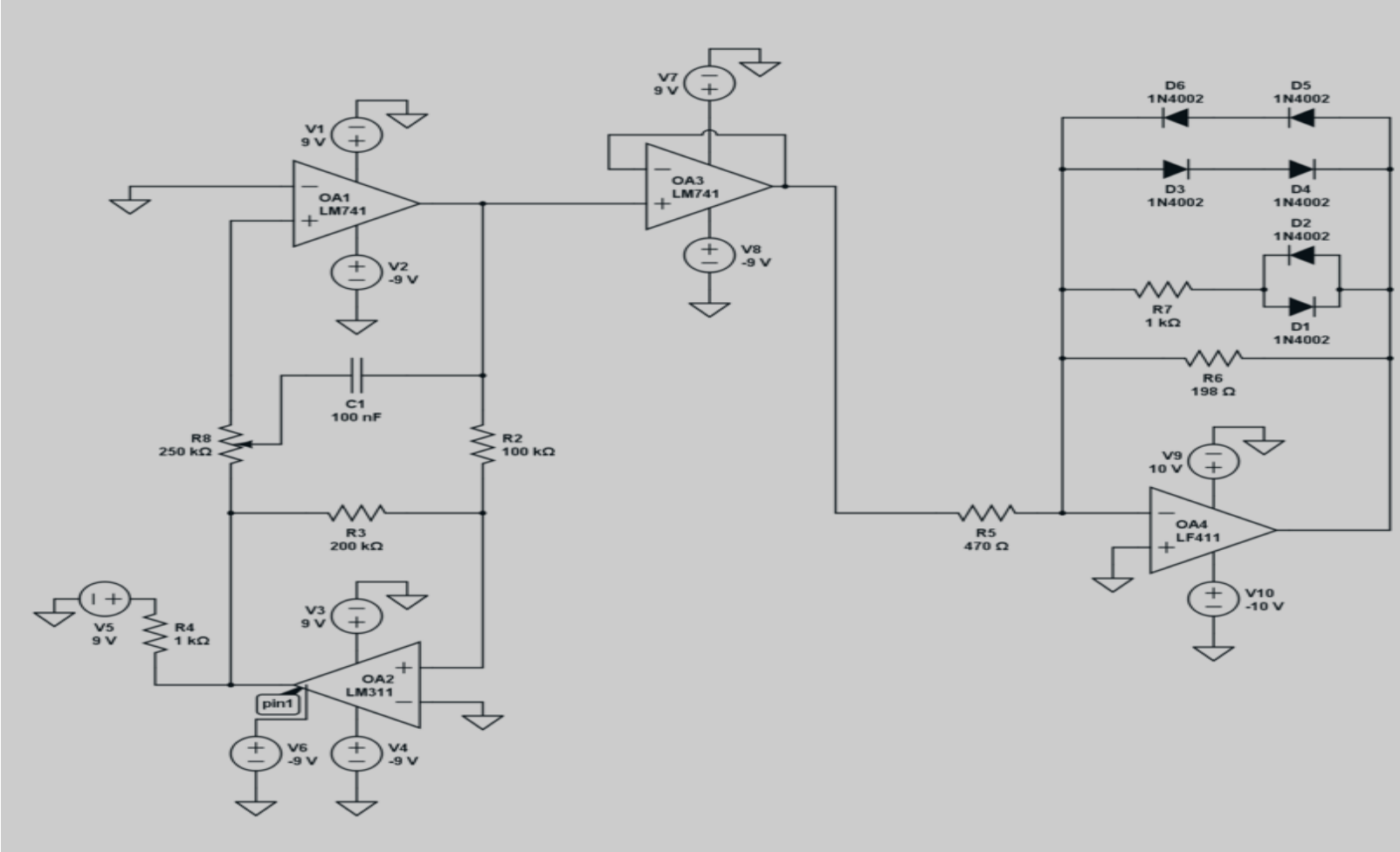


<POWER CIRCUIT>

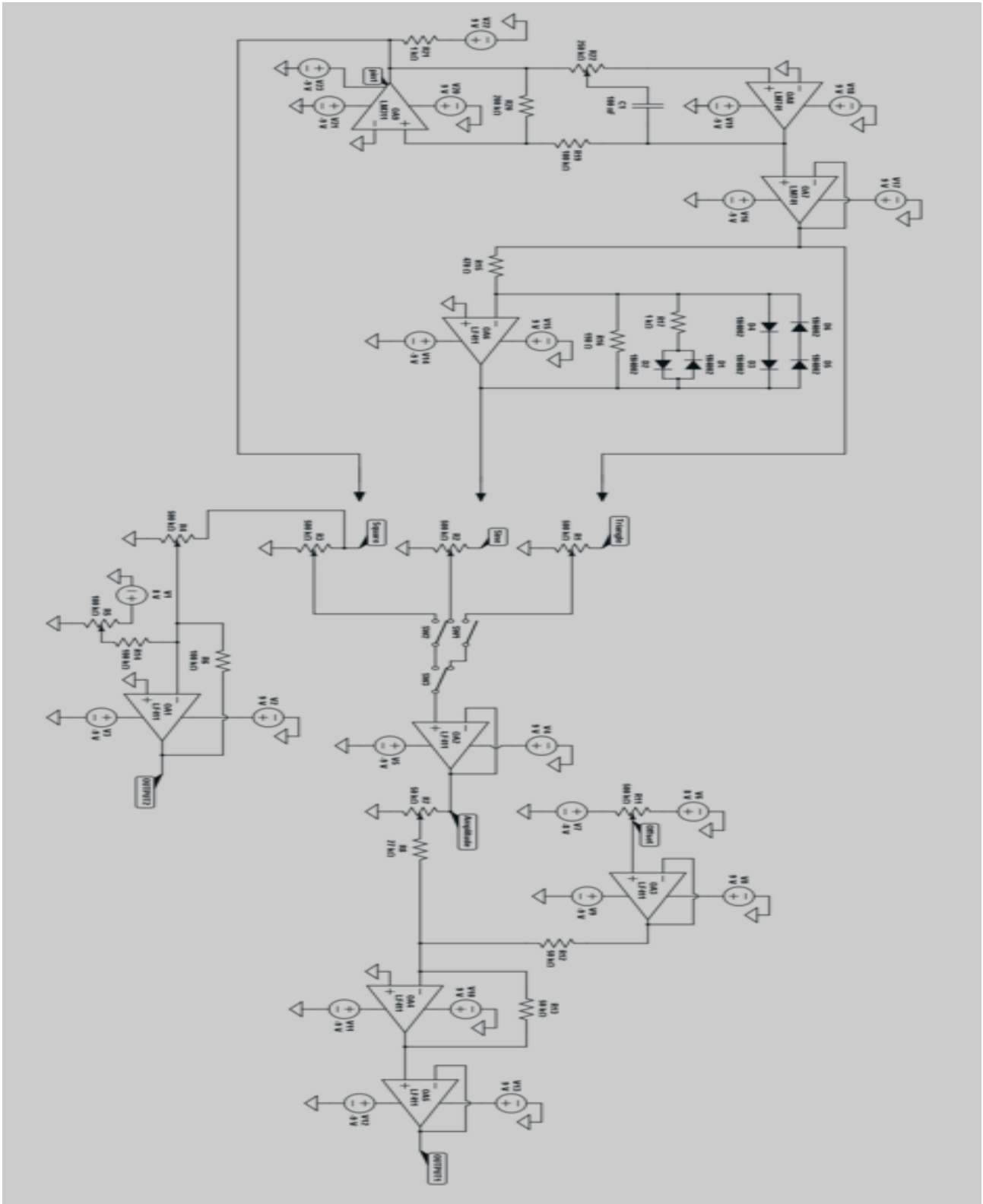
4.1.2 OSCILLATOR CIRCUIT

This is the main part of the function generator circuit. Triangular wave generator circuit and the wave shaper circuit are separated by a buffer.

The triangular wave circuit has a Schmitt trigger and an integrator. This oscillator circuit gives two outputs , a square wave and a triangular wave.



4.1.3 THE WHOLE SCHEMATIC OF FUNCTION GENERATOR



4.2 COMPONENTS

4.3 TROUBLESHOOING TIPS

4.4 TESTING RESULTS

4.5 POWER CONSUMPTION

The CVGEN21X™ uses two (2) 9V Alkaline Batteries as power source.

The circuit draws about 77 mA from both batteries combined.

The total life durability of the batteries is 14.67 Hours per set of batteries.

4.6 COST ANALYSIS

The estimated cost of our product is $27.224

The list of components by their price is as follows:

Element	Quantity	Part Number	Value	Tolerance	Description	Price($)
Battery	2	Standard	9V		Battery	4.5
R21	1	Standard	1k	E24: 5%	Resistor	0.07
OA8 LM741	1	Standard			OpAmp	0.29
C1	1	Standard	100 nF	E12: 10%	Capacitor	0.12
R22	1	Standard	250k	E24: 5%	potentiometer	1.55
R19	1	Standard	100k	E24: 5%	Resistor	0.005
R20	1	Standard	200k	E24: 5%	Resistor	0.042
OA9 LM311	1	Standard			OpAmp	0.155
OA7 LM741	1	Standard			OpAmp	0.29
D1 1N4002	1	Standard			Diode	0.021
D2 1N4002	1	Standard			Diode	0.021
D3 1N4002	1	Standard			Diode	0.021
D4 1N4002	1	Standard			Diode	0.021
D5 1N4002	1	Standard			Diode	0.021
D6 1N4002	1	Standard			Diode	0.021
R17	1	Standard	1k	E24: 5%	Resistor	0.07
R16	1	Standard	198	E24: 5%	Resistor	0.084
R15	1	Standard	470	E24: 5%	Resistor	0.099
OA6 LF411	1	Standard			OpAmp	1.25
R1	1	Standard	500k	E24: 5%	potentiometer	1.55
R2	1	Standard	500k	E24: 5%	potentiometer	1.55
R3	1	Standard	500k	E24: 5%	potentiometer	1.55
R4	1	Standard	500k	E24: 5%	potentiometer	1.55
SW(1,2,3)	1	Standard			switch rotary shaft	1.25
R5	1	Standard	500k	E24: 5%	potentiometer	1.55
R14	1	Standard	100k	E24: 5%	Resistor	0.005
R6	1	Standard	100k	E24: 5%	Resistor	0.005
OA1 LF411	1	Standard			OpAmp	1.25
OA2 LF411	1	Standard			OpAmp	1.25
R7	1	Standard	50k	E24: 5%	potentiometer	1.55
R11	1	Standard	500k	E24: 5%	Resistor	0.084
R8	1	Standard	27k	E24: 5%	Resistor	0.021
OA3 LF411	1	Standard			OpAmp	1.25
R12	1	Standard	50k	E24: 5%	Resistor	0.084
R13	1	Standard	50k	E24: 5%	Resistor	0.084
OA4 LF411	1	Standard			OpAmp	1.25
OA5 LF411	1	Standard			OpAmp	1.25
SW(power)	1	Standard			switch	1.49
					Total:	27.224

5 SERVICE MANAGEMENT

[Enter information describing how system service will be managed or provide a reference to where it is stored.]

6 KEY CONTACTS

[Enter information describing key contacts and associated contact information or provide a reference to where it is stored.]

7 ROLES AND RESPONSIBILITIES

CV Electronics products are gaining popularity amongst its users. We are proud of our excellent team:

Lead Engineer: Jesus Sanchez

With his excellent leadership skills Jesus Sanchez always leads the team on the right way. He always invites suggestions from all the team members and finds innovative ways to work efficiently. He is a great encouragement for the team. CV Electronics sees bright future under his leadership.

Design ngineer: Tianyu Lin

Tianyu Lin is the most experienced engineer of our team. With his excellent knowledge in the field of electronics CV Electronics is able to implement new innovations in the products in the favor of our customers.

Assistant design engineer: Song Jiazhang

Song Jiazhang, the right hand of Tianyu Lin, who is excellent at designing the circuits due to his experience with software. He plays a key role for setting apart the CV Electronics' products from our competitors.

Quality engineers: Thanh Orr

Thanh Orr is known for his finishing skills. Because of his great efforts, CV Electronics' products are attractive and user friendly. He makes sure that the finish product has high quality and meets the need of our customers

Process Engineer: Virashree Patel

Virashree Patel possesses an extensive set of technical and intrapersonal skills. She focuses on developing a cost effective and working production process. She is a team player who is a key person in the operations of CV Electronics design group.

8 REGULATORY REQUIREMENTS

[Enter information describing regulatory and policies compliance requirements or provide a reference to where it is stored.]

9 FAQS

[Enter information requiring frequently asked questions and associated answers or provide a reference to where it is stored.]

Appendix A: Operations & Maintenance Manual Approval

The undersigned acknowledge they have reviewed the *<Project Name>* **Operations & Maintenance Manual** and agree with the approach it presents. Changes to this **Operations & Maintenance Manual** will be coordinated with and approved by the undersigned or their designated representatives.

[List the individuals whose signatures are desired. Examples of such individuals are Business Steward, Implementation Manager or Project Sponsor. Add additional lines for signature as necessary. Although signatures are desired, they are not always required to move forward with the practices outlined within this document.]

Signature: _____ Date: _____

Print Name: _____

Title: _____

Role: _____

Signature: _____ Date: _____

Print Name: _____

Title: _____

Role: _____

Signature: _____ Date: _____

Print Name: _____

Title: _____

Role: _____

APPENDIX B: REFERENCES

[Insert the name, version number, description, and physical location of any documents referenced in this document. Add rows to the table as necessary.]

The following table summarizes the documents referenced in this document.

Document Name and Version	Description	Location
<Document Name and Version Number>	*[Provide description of the document]*	*<URL or Network path where document is located>*

APPENDIX C: KEY TERMS

[Insert terms and definitions used in this document. Add rows to the table as necessary. Follow the link below to for definitions of project management terms and acronyms used in this and other documents.

The following table provides definitions for terms relevant to this document.

Term	Definition
[Insert Term]	*[Provide definition of the term used in this document.]*
[Insert Term]	*[Provide definition of the term used in this document.]*
[Insert Term]	*[Provide definition of the term used in this document.]*