PROJECT NAME HERE

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**Functional System Requirements**

**subsystem if needed**

REVISION – Draft

25 January 2018

Functional System Requirements

for

Project Name Here

Prepared by:

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Author Date

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Project Leader Date

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John Lusher, P.E. Date

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[**1.** **Introduction** **1**](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692793)

[1.1. Purpose and Scope 1](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692794)

[1.2. Responsibility and Change Authority 1](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692795)

[**2.** **Applicable and Reference Documents. 2**](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692796)

[2.1. Applicable Documents 2](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692797)

[2.2. Reference Documents 2](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692798)

[2.3. Order of Precedence 3](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692799)

[**3.** **Requirements** **4**](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692800)

[3.1. System Definition 4](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692801)

[3.2. Characteristics 4](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692802)

[3.2.1. Functional / Performance Requirements 4](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692803)

[3.2.2. Physical Characteristics 5](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692804)

[3.2.3. Electrical Characteristics 6](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692805)

[3.2.4. Environmental Requirements 8](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692806)

[3.2.5. Failure Propagation 9](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692807)

[**4.** **Support Requirements. 10**](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692808)

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[**Appendix B Definition of Terms** **12**](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692810)

[**Appendix C Interface Control Documents** **12**](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692811)

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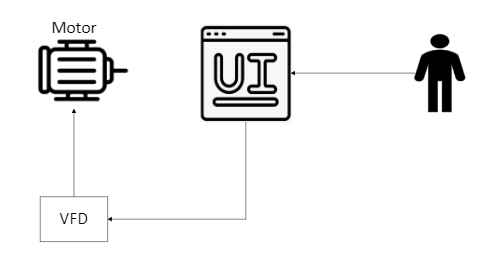
[**Figure 2. Block Diagram of System** **4**](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?new=1&ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Ftamucs.sharepoint.com%2Fteams%2FTeam-ECEN-903-403%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F2e2c8d32300e4820bede9d7cf4ee71bf&wdorigin=TEAMS-MAGLEV.teamsSdk_ns.rwc&wdexp=TEAMS-TREATMENT&wdhostclicktime=1726968996069&wdenableroaming=1&mscc=1&hid=C89852A1-001A-6000-6568-73FCB31253B3.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&usid=3f2b5b29-00d2-391f-720c-fd1d04c70cec&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Ftamucs.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdredirectionreason=Unified_SingleFlush#_Toc442692813)

# **1.** **Introduction**

## ***1.1.*** ***Purpose and Scope***

The VFD motor controller is intended to control the speed and torque of an AC motor by varying the frequency and voltage supplied. This project will use three phase power as the input that will be converted to DC and then transmitted to a microcontroller via optoelectronics and used to power a motor. The microcontroller also will send signals to the DC link, again using optoelectronics, that contain the desired frequency. The VFD motor controller will come with a user interface that allows the user to input the frequency needed and start or stop the system as needed. This VFD shall be implemented to increase efficiency and save energy.

**Figure 1. (DRAFT can change)**



The following definitions differentiate between requirements and other statements.

Shall: This is the only verb used for the binding requirements.

Should/May: These verbs are used for stating non-mandatory goals.

Will: This verb is used for stating facts or declaration of purpose.

## ***1.2.*** ***Responsibility and Change Authority***

Briefly describe who has the responsibility for making sure the requirements are met (i.e., team leader) and who has the authority to make the changes (i.e., client and team leader).

# **2.** **Applicable and Reference Documents**

## ***2.1.*** ***Applicable Documents***

The following documents, of the exact issue and revision shown, form a part of this specification to the extent specified herein:

NOTE: examples below, make sure what you use really is what you want to follow!!!! I really would not call out MIL-STD-810 for your project!

|  |  |  |
| --- | --- | --- |
| **Document Number** | **Revision/Release Date** | **Document Title** |
| IEEE 519-2014 | 27 March 2014 | Standard for Harmonics |

## ***2.2.*** ***Reference Documents***

The following documents are reference documents utilized in the development of this specification. These documents do not form a part of this specification and are not controlled by their reference herein.

|  |  |  |
| --- | --- | --- |
| **Document Number** | **Revision/Release Date** | **Document Title** |
|  |  |  |
|  |  |  |

## ***2.3.*** ***Order of Precedence***

In the event of a conflict between the text of this specification and an applicable document cited herein, the text of this specification takes precedence without any exceptions.

All specifications, standards, exhibits, drawings or other documents that are invoked as “applicable” in this specification are incorporated as cited. All documents that are referred to within an applicable report are considered to be for guidance and information only, except ICDs that have their relevant documents considered to be incorporated as cited.

# **3.** **Requirements**

This section defines the minimum requirements that the development item(s) must meet. The requirements and constraints that apply to performance, design, interoperability, reliability, etc., of the system, are covered.

## ***3.1.*** ***System Definition (maybe change this is basically the conop)***

The VFD motor controller is comprised of a DC link (includes a rectifier and DC bus), power controller, microcontroller, and optoelectronics. The DC link converts AC input into DC and minimizes the noise of the DC signal. The power controller controls the voltage. The microcontroller is used to produce PWM signals that will drive the motor. Optoelectronics allows for communication between the high voltage side and the low voltage microcontroller.

This is a four-person project, and the roles are be split into:

* Firmware (Ryan Reagan):
  + Write code in C that allows the rest of the VFD circuit to plug into the microcontroller and function according to desired specifications (how fast does the user want the motor to run).
  + Improve code to potentially include closed loop function (PID loop including VFD, controller, motor, and tachometer to detect motor speed) that would allow for automatic functionality with a given speed setpoint entered into the code
  + Design and program a user-interface that gives the user access to controlling different features such as the setpoint and start/stop as well as visualize information such as current motor speed, controller output to the VFD, and VFD voltage and current provided to the motor
* Sensors (Mackenzie Miller):
  + The first part of the sensors portion includes two optoelectronic circuits. One of those takes digital signals in and directly converts them to analog. The second, being more complicated, takes analog input, then, using an opto-isolator, the circuit converts the input to digital signals to be sent to the microcontroller. The analog side of the project works with very high voltage, while the digital side works with low voltage. Because of this, the two sides cannot be connected or the microcontroller will be overpowered and break, so the optoelectronics send signals and data across using light.
  + The second part of the sensors portion is a constant current and voltage measurement. This will be done using a current sensing resistor, which has a very small resistance, and a simple voltage divider circuit. These measurements will then be sent back to the firmware.
  + Finally, there will be a tachometer that measures the RPMs of the motor that is also sent to the firmware.
* Microcontroller (Andrew Nguyen):
  + The MCU is supplied by the 15 VDC from the AC power supply fed by the main power. The voltage will then be stepped down to a usable 3.3V. It receives feedback through low-voltage analog signals that represent voltage and current. The MCU will then send out PWM signals to the H bridge and power control system which are used to control the inverter stage of the VFD which helps to adjust the output voltage and frequency supplied to the motor.
* Rectifier and DC Link (Aidan Rader):
  + The rectifier takes in three-phase AC power and converts it into DC power. For each phase, there are parallel diodes acting as a one-way bridge for the current allowing it to flow in only one direction. To maintain the correct current polarity the diode opens and closes in sequence as the AC waveform alternates. The DC output is then filtered by capacitors within the DC link to provide a stable DC voltage for the microprocessor.

**Figure 2. Block Diagram of System**

Describe the block diagram, what are the subsystems, how do they interconnect. Someone reading this section should get a general idea of what you are building, why, and how it will solve the problem you are solving.

## ***3.2.*** ***Characteristics***

### **3.2.1.** **Functional / Performance Requirements**

#### **3.2.1.1.** **Requirement #1**

This is where you list functional requirements such as meeting the “big picture.” For example, for a search and rescue system, you would like the following few functional requirements… Also, units of measure should be consistent with your audience. In the examples below there is a fix for English units and SI units that is because the target customer understands and expects to see those units.

Also, if possible give rationale to the requirement. This way you know why this requirement was specified.

#### **3.2.1.2.** **Search Probability of Detection**

The Search and Rescue System shall meet a threshold objective of 90% probability of detection for direct crossover under Base 1 conditions specified in Appendix C (Base 1 Conditions).

*Rationale: This is the core system performance requirement. Base 1 conditions originate from the environment measured at National Data Buoy Center (NDBC) station 42035, located 22 NM off the coast of Galveston, Texas at (29.232, -94.413), the designated location for system tests.*

#### **3.2.1.3.** **Operational Search Altitude**

The Search and Rescue System shall support a search altitude from ### ft to ### ft AGL.

*Rationale: The Search and Rescue System has a XXX° FOV and operates with a ### ft to ### ft search altitude for an operational search sweep width from ### ft (~#### NM) to #### ft (~### NM) for a range of targets such as a XXXXX and XXXX respectively.*

### **3.2.2.** **Physical Characteristics**

This is the area where you will specify any requirements regarding the physical characteristics of your system. Does the system need to not have a mass/weight higher than X, etc.? There are examples shown below…

#### **3.2.2.1.** **Mass**

The mass of the Search and Rescue System shall be less than or equal to ### kilograms.

*Rationale: This is a requirement specified by our customer due to constraints of their system in which the Search and Rescue System is integrating.*

#### **3.2.2.2.** **Volume Envelope**

The volume envelope of the Search and Rescue System shall be less than or equal to ### inches in height, ### inches in width, and ### inches in length.

*Rationale: This is a requirement specified by our customer due to constraints of their system in which the Search and Rescue System is integrating.*

#### **3.2.2.3.** **Mounting**

The mounting information for the Search and Rescue System shall be captured in the Search and Rescue System ICD.

*Rationale: As the Search and Rescue System mounts to platform system, the interface between the two includes mechanical, electrical and thermal details.*

### **3.2.3.** **Electrical Characteristics**

#### **3.2.3.1.** **Inputs**

1. The presence or absence of any combination of the input signals in accordance with ICD specifications applied in any sequence shall not damage the Search and Rescue System, reduce its life expectancy, or cause any malfunction, either when the unit is powered or when it is not.

1. No sequence of command shall damage the Search and Rescue System, reduce its life expectancy, or cause any malfunction.

*Rationale: By design, should limit the chance of damage or malfunction by user/technician error.*

##### **3.2.3.1.1** **Power Consumption**

1. The maximum peak power of the system shall not exceed ### watts.

*Rationale: This is a requirement specified by our customer due to constraints of their system in which the Search and Rescue System is integrating.*

##### **3.2.3.1.2** **Input Voltage Level**

The input voltage level for the Search and Rescue System shall be +22 VDC to +29 VDC.

*Rationale: Aircraft bus specification compatibility, MIL-STD-704F*

##### **3.2.3.1.3** **Input Noise and Ripple**

The input noise and ripple for the Search and Rescue System shall operate while in the presence of a 1.5 Volt RMS ripple superimposed on the steady-state voltage over the frequency range of 0 Hz to AC.

*Rationale: Aircraft bus specification compatibility, MIL-STD-704F*

##### **3.2.3.1.4** **External Commands**

The Search and Rescue System shall document all external commands in the appropriate ICD.

*Rationale: The ICD will capture all interface details from the low level electrical to the high-level packet format.*

#### **3.2.3.2.** **Outputs**

##### **3.2.3.2.1** **Data Output**

The Search and Rescue System shall include an interface compatible with the data system.

*Rationale: The Search and Rescue information passes directly to the customer’s system.*

##### **3.2.3.2.2** **Diagnostic Output**

The Search and Rescue System shall include a diagnostic interface for control and data logging.

*Rationale: Provides the ability to control things for debugging manually and a way to view/download the node map with associated potential targets.*

##### **3.2.3.2.3** **Raw Video Output**

The Search and Rescue System central unit shall include a raw video interface to support external recording.

*Rationale: Too much data to store internally. Would be used for diagnostics.*

#### **3.2.3.3.** **Connectors**

The Search and Rescue System shall use external connectors in accordance with MIL-DTL-38999.

*Rationale: This is a requirement specified by our customer due to constraints of their system in which the Search and Rescue System is integrating.*

#### **3.2.3.4.** **Wiring**

The Search and Rescue System shall follow the guidelines outlined in MIL-HDBK-5400 paragraph 4.3.35 Wire and cable.

*Rationale: Conform to aircraft standard.*

### **3.2.4.** **Environmental Requirements**

The Search and Rescue System shall be designed to withstand and operate in the environments and laboratory tests specified in the following section.

*Rationale: This is a requirement specified by our customer due to constraints of their system in which the Search and Rescue System is integrating.*

#### **3.2.4.1.** **Pressure (Altitude)**

#### **3.2.4.2.** **Thermal**

#### **3.2.4.3.** **External Contamination**

#### **3.2.4.4.** **Rain**

#### **3.2.4.5.** **Humidity**

etc….you get the idea

### **3.2.5.** **Failure Propagation**

The Search and Rescue System shall not allow propagation of faults beyond the Search and Rescue System interface.

#### **3.2.5.1.** **Failure Detection, Isolation, and Recovery (FDIR)**

##### **3.2.5.1.1** **Built In Test (BIT)**

The Search and Rescue System shall have an internal subsystem that will generate test signals and evaluate the Search and Rescue System responses and determine if there is a failure.

###### **3.2.5.1.1.1** **BIT Critical Fault Detection**

The BIT shall be able to detect a critical fault in the Search and Rescue System 95 percent of the time.

*Rationale: This is a requirement specified by our customer due to constraints of their system in which the Search and Rescue System is integrating.*

###### **3.2.5.1.1.2** **BIT False Alarms**

The BIT shall have a false alarm rate of less than 5 percent.

*Rationale: This is a requirement specified by our customer due to constraints of their system in which the Search and Rescue System is integrating.*

###### **3.2.5.1.1.3** **BIT Log**

The BIT shall save the results of each test to a log that shall be stored in the Search and Rescue System for retrieval and clearing by maintenance personnel.

*Rationale: This is a requirement specified by our customer due to constraints of their system in which the Search and Rescue System is integrating.*

##### **3.2.5.1.2** **Isolation and Recovery**

The Search and Rescue System should provide for fault isolation and recovery by enabling subsystems to be reset or disabled based upon the result of the BIT.

*Rationale: This is a requirement specified by our customer due to constraints of their system in which the Search and Rescue System is integrating.*

# **4.** **Support Requirements**

Provide details of provided support or requirements for the customer such as the fact that the system requires a laptop with listed requirements. What will you provide with the system? Are there any requirements for technical support service or warranty? How will you resolve issues in the field? This section may be long, or may not be needed at all depending on the project and customer requirements.

# **Appendix A: Acronyms and Abbreviations**

Below is a list of common acronyms and abbreviations, update based upon your project….

BIT Built-In Test

CCA Circuit Card Assembly

EMC Electromagnetic Compatibility

EMI Electromagnetic Interference

EO/IR Electro-optical Infrared

FOR Field of Regard

FOV Field of View

GPS Global Positioning System

GUI Graphical User Interface

Hz Hertz

ICD Interface Control Document

kHz Kilohertz (1,000 Hz)

LCD Liquid Crystal Display

LED Light-emitting Diode

mA Milliamp

MHz Megahertz (1,000,000 Hz)

MTBF Mean Time Between Failure

MTTR Mean Time To Repair

mW Milliwatt

PCB Printed Circuit Board

RMS Root Mean Square

TBD To Be Determined

TTL Transistor-Transistor Logic

USB Universal Serial Bus

VME VERSA-Module Europe

# **Appendix B: Definition of Terms**

Specify anything that needs definition….

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