

Process / Product Failure Modes and Effects Analysis (FMEA)

Process or Product Name: Sistema Palpador Robótico Cartesiano (SPARC)						Prepared by: Hayde Zamudio										
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Module / Part	PRs	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	Occ	Current Controls	DET	RPN	Actions Recommended	Resp.	Test Case Associated	SEV	Occ	RPN	
What is being analyzed?	What are the requirements that might be affected by the software change?	In what way could the process step/function potentially fail to meet process requirements or intent?	What is the impact on the Key Output Variables (Customer Requirements) or internal requirements?	How Severe is the effect to the customer?	What are the causes of this Failure Mode? Typical causes result from process input failures (review Process Map).	How often does cause occur?	What are the existing controls and procedures (inspection and test) that prevent the cause or the Failure Mode? Should include an SOP number.	How well can you detect cause of FMEA?	SEV * Occ * DET	What are the actions for reducing the occurrence of the Cause, or improving detection? Should have actions only on high RPN's or easy fixes.	Who is Responsible for the recommended action?	Which test case verify that everything is ok?				
Movimiento general de los ejes x,y &z.	Automatización de ejes X y Y.	Que no se mueva X	El producto no hace su función	8	Los pines no estan configurados como digital I/O, función de relación de movimiento mal implementada, error en ecuación de conversión (comandos-pasos), no se incluyeron las librerías del driver correspondiente, no se desactivaron todas las funciones secundarias de los pines asignados, el formato de los comandos enviados no corresponden al protocolo implementado.	10	Realtime debugger, prueba de banco	3	240	Checkar el programa linea por linea con ayuda del realtime debugger,probar los motores por si solos,probar los motores en conjunto fuera del chasis final, verificar que se cumplan los requerimientos del driver.	Testing team		8	10	3 240	
		Que no se mueva Y		8		10		3 240	Testing team	8	10	3 240				
		Que no se mueva ninguno		8		10		3 240	Testing team	8	10	3 240				
		Llega a una coordenada que está más alla de +/- 1mm de error	El desempeño del dispositivo no es perfecto, y podría conllevar algunos problemas.	5	Función de relación de movimiento mal implementada, error en ecuación de conversión (comandos-pasos), el formato de los comandos enviados no corresponden al protocolo implementado.	8		4	160	Medir diferencia de distancias, revisar ecuación de conversión y su implementación.	Testing team	5	8	4 160		
	Actuador eje z, click del robot	Que no baje	El producto no hace su función	8	Que los pines no esten configurados como digital I/O,función de relación de movimiento mal implementada,error en ecuación de equivalencia (distancia-ángulo),no se incluyeron las librerías del driver correspondiente, no se desactivaron todas las funciones secundarias de los pines asignados, el formato de los comandos enviados no corresponden al protocolo implementado.	10	Realtime debugger, prueba de banco	3	240	Checkar el programa linea por linea con ayuda del realtime debugger,probar el motor en y fuera del chasis final, verificar que se cumplan los requerimientos del driver.	Testing team		8	10	3 240	
		Que no suba		8		10		3 240	Testing team	8	10	3 240				
	Movimiento específico del actuador z	Click o deslamiento	Que no haga click	El desempeño del dispositivo no es perfecto, y podría conllevar algunos problemas.	8	No se definió el bit que lleva la información que especifica el usuario, se está leyendo el bit o pin incorrecto, error en la relación información-movimiento.	10	Realtime debugger, prueba de banco	3	240	Checkar el programa linea por linea con ayuda del realtime debugger, verificar orden del paquete de datos recibido, checar relación información-movimiento,probar el funcionamiento en y fuera del chasis final,	Testing team		8	10	3 240
			Que no deslice		8		10		3 240	Testing team	8	10	3 240			
Que no haga ninguno			El producto no hace su función	8	10		3 240		Testing team	8	10	3 240				
Comunicación	Comunicación por UART	Que no se comunique	Comportamiento inesperado, que no se mueva	8	Que el baudaje no esté bien configurado,que la iniciación no esté bien hecha.	10	prueba de banco	3	240	Revisar baudaje especificado en ambos extremos, inicialización, paquete de datos enviado, paridad,y lectura de pines.	Testing team		8	10	3 240	
		Que pierda información		8	Que la iniciación no esté bien hecha,que la lectura de los pines no corresponda, que no este identificando el bit de paro, que la paridad no corresponda.	10	prueba de banco	3	240		Testing team	8	10	3 240		
		Que mande basura		8		10	prueba de banco	3	240		Testing team	8	10	3 240		
	Estado del sistema	Mensajes de estado	No manda mensaje de "Listo, esperando comando"	Insatisfacción del usuario por no saber el estado del proceso.	5	Error en las condiciones para desplegar mensaje, falta definir mensaje.	6	Realtime debugger	2	60	Checkar el programa linea por linea con ayuda del realtime debugger	Testing team		5	6	2 60
			No manda mensaje de "Comando recibido"		5		6	Realtime debugger	2	60		Testing team	5	6	2 60	
			No manda mensaje de "Comando ejecutado"		5		6	Realtime debugger	2	60		Testing team	5	6	2 60	
No manda mensaje de "Error"			No avisa al usuario a tiempo para que intervenga y busque solución.		5		6	Realtime debugger	2	60		Testing team	5	6	2 60	
Leds de estado	No enciende LED de "Error"	No avisa al usuario a tiempo para que intervenga y busque solución.	5	Error en las condiciones para encender LED, el pin no está configurado como salida, falta desactivar funciones secundarias del pin.	6	Realtime debugger, prueba de banco	2	60	Checkar el programa linea por linea con ayuda del realtime debugger	Testing team		5	6	2 60		
Reset del sistema	Reset	No se resetea el programa	El sistema no puede volver a empezar desde cero.	7	Error en las instrucciones de reinicio, error en los comandos de posición (0,0), error en los loops, error en las interrupciones.	5	Realtime debugger, prueba de banco	3	105	Checkar el programa linea por linea con ayuda del realtime debugger	Testing team		7	5	3 105	
Peso del dispositivo	El peso total del robot cartesiano debe ser menor a 15 kilogramos	No se podrá trasladar con facilidad	El dispositivo será demasiado pesado como para ser manipulado y transportado por	5	Uso de materiales innecesariamente pesados	5	Simulación previa de peso usando el programa de diseño	4	100	Realizar simulaciones previas con distintos posibles materiales para calcular su peso	Testing team		5	5	4 100	
								0							0	
								0							0	
{Module / Part}	{PRS_ID}	{Control_does_not_perform_functionality_}	{Client_will_see}		{Routine_does_not_}		{Code_Peer_Reviews, Bench_Test, Test_Case_Design, Design_Test_Plan, Test_Plan_Review, Test_Run (Black_Box_Test), Test_Run_Review, Thermal_Performance_Test}			{ACTION_DESCRIPTION}	{REPSONSIBLES_NAMES}	{LINK_TEST_CASE LINK_DOCUMENT TEST_SPEC}				

**Proposal:**

- In this column the idea is to use the PRS affected by the change.

**Reason(s):**

- Since it is harder to analyze the source code modules affected by the change and the involved functionality. Normally in the modules there is a mix of functionality.
- Based on PRS would make easier to fill the PFM and PFE columns

**Proposal:**

- Identify the effect on the customer

**Reason(s):**

- This FMEA is centered in the customer

**Proposal:**

- Identify what could happen in the code to break this functionality. Do not evaluate if a hardware component failed.

**Reason(s):**

- This is a Software FMEA.

**Proposal:**

- Identify what could be set a list of current controls that apply to all cases, those controls could be: Test Plan Design, code review, Bench test, Test runs, test plan review, etc. and these can be the same for all

**Reason(s):**

- This is a Software FMEA.

**Proposal:**

- Here add in a generic idea of what to test

**Reason(s):**

- The intention in this column is to identify what we want to validate.

**Proposal:**

- Here add the tests cases to be run
- Also can be added suggestions for the Hardware team.

**Reason(s):**

- The purpose of this FMEA is to define the test cases for the test plan.

**Proposal:**

- Identify and write down in separate rows the different functionality (outputs) identified in the requirement and the failure mode will be that it is not performed.

**Reason(s):**

- Because it is the output for the customer, using code will create more complexity and we can get lost easily
- Splitting the outputs give granularity

**Proposal:**

- Use the severity range table.
- Customer focused (end customer or plant)

**Reason(s):**

- This is a Software FMEA.

**Proposal:**

- Range based on likelihood that the end customer has access to this functionality
- In Case of plant occurrence has to be very high.

**Reason(s):**

- From software perspective occurrence is very high since failures are not intermittent.

**Proposal:**

- The way to rank it is: on the likelihood the tester can find the bug.

**Reason(s):**

- Customer focused

**Proposal:**

- Here normally the direct responsible are the testers but also the reviewers and DQA

**Reason(s):**

- All involved in the validation process are responsible in some way

**Proposal:**

- In this section the only affected item is the detection.
- The way to rank it is: on the likelihood the tester can find the bug with the test cases

**Reason(s):**

- There are no functionality changes in the scope of a VE project

	Severity	Occurrence	Detection
1	Customer will not notice and no effect on performance	Remote, user access to functionality is unlikely	Almost certain tester to see the failure
2	Customer will not notice, minor effect on performance	Low, user access to functionality is few and far between	Very high chance tester to see the failure
3	Customer will experience a minor nuisance but no performance loss	Low, relatively few user access to functionality	High chance tester to see the failure
4	Customer minor dissatisfaction due to minor performance loss	Moderately low, infrequent user access to functionality	Moderately high chance tester to see the failure
5	Customer dissatisfaction due to see a partial malfunction which is likely to result in a complaint	Moderate, occasional user access to functionality	Moderate chance tester to see the failure
6	Customer is made uncomfortable because a loss of performance	Moderately high, frequent user access to functionality	Low chance tester to see the failure
7	Customer high dissatisfaction due to partial software functionality failure without complete loss of function	High, user access to functionality occurs often	Very low chance tester to see the failure
8	Customer very high degree of dissatisfaction due to complete loss of functionality without a negative impact on	High, repeated user access to functionality	Remote chance tester to see the failure
9	The product infringes governmental regulations	High, user access to functionality occurs almost as often as not	Very remote chance tester to see the failure
10	The product can injure a customer	Very High, user access to functionality is almost inevitable	No chance tester to see the failure