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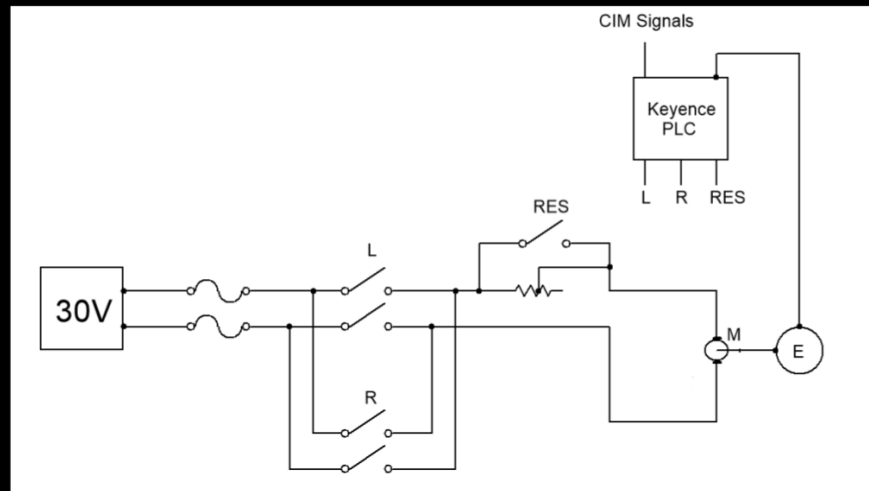
by David Harries

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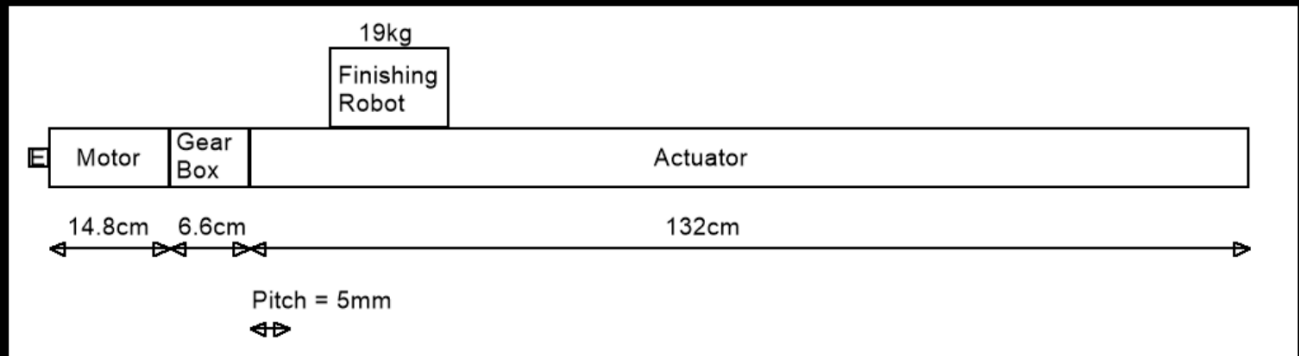
SGEE6003: Major Project

Linear Drive System

Project Background



Project Background



Problem Definition

- Poor positioning control,
- Low maximum velocity,
- Only two speeds,
- Lacks diagnostic functions and data acquisition.

Function Design Specification

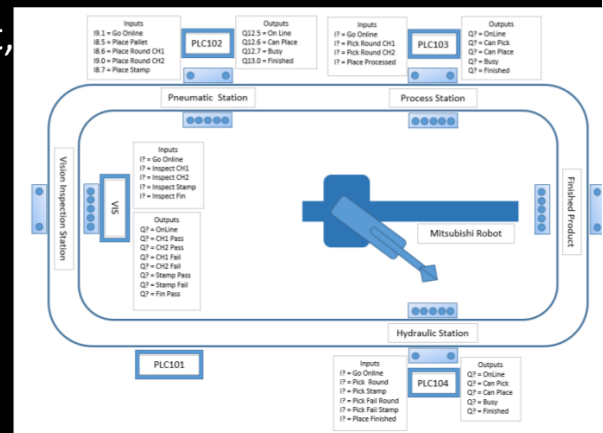
Hardware Upgrades

- Minimum linear velocity of 43mm/s, 500rpm, 1.834Nm,
- Ideal linear velocity of 176mm/s, 2200rpm, 7.6Nm,
- Variable speed control,
- Position control using Incremental Encoder Feedback,
- PROFINET network integration,
- Four-quadrant operation,
- Budget: £1100.

Function Design Specification

Software Upgrades

- Animated mimic of finishing robot,
- Diagnostic tools integrated into HMI,
- Automatic control from Mitsubishi Robot,
- Manual control from HMI.



Function Design Specification

Enclosure

- 500mm x 800mm x 250mm,
- Transparent plexiglass door,
- Interlock guard and safety lock isolator.

Risks

	Minor	Moderate	Major	Critical
76-100%				
51-75%				
26-50%	Software Issues			
0-25%	Delay on Delivery of Order			Physical Damage to Components

Table 2

Health and Safety

- Risk assessment (HASAW act 1974)
- Safe torque off capabilities (ISO 10218 Part 1)
- Safety-rated monitored stop (ISO 10218 Part 1)
- Enclosure safety (Provision and Use of Work Equipment Regulations 1998)
- Emergency stop (BS EN ISO 13850)

Environment and Sustainability

- More efficient motor,
- Recyclable materials,
- Reusing technology,
- Regenerative braking,
- PROFlenergy.

Test Planning

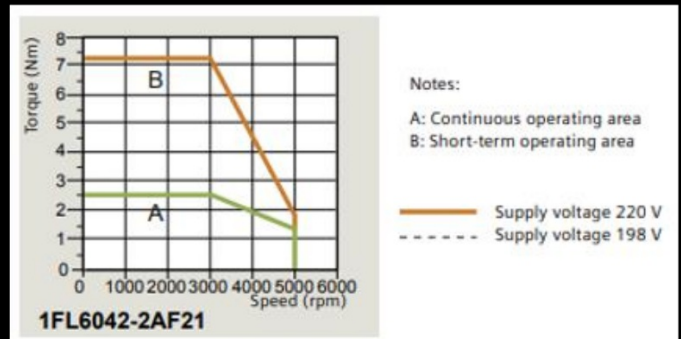
- Initial test plan; Page 13, Section 4.2.
- Hardware and Software tests.

Solutions

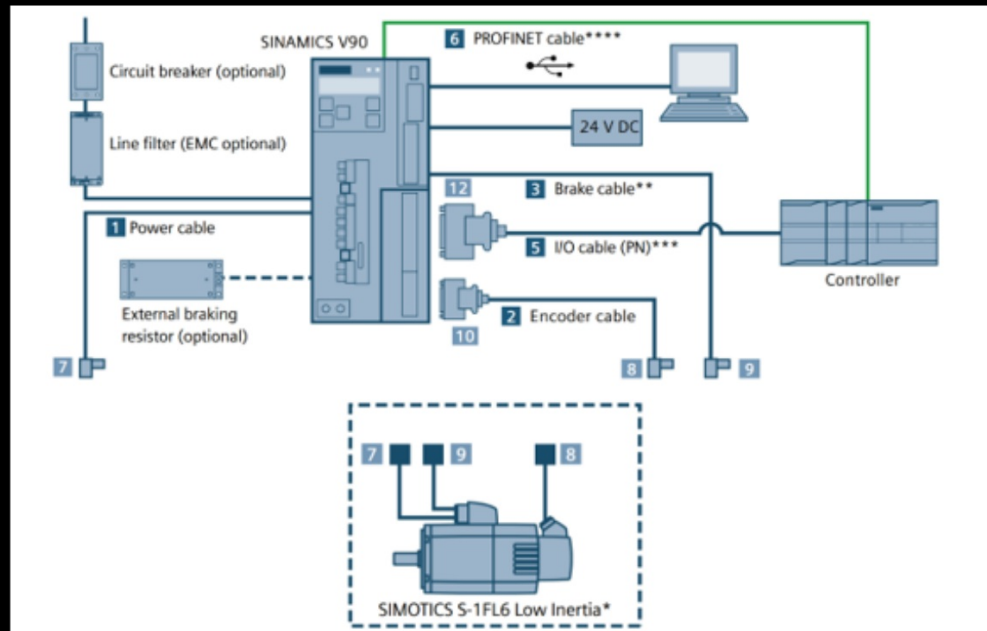
Servo motor

- Constant torque at range of speeds,
- Can provide 300% torque for short periods,
- Good for position control,
- Often have integrated encoder.

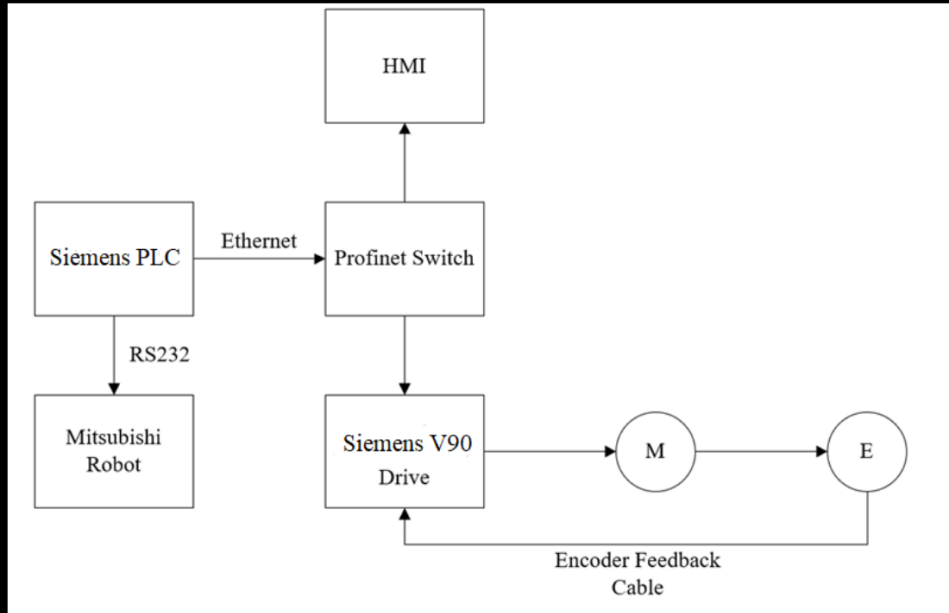
Siemens V90 Drive and S-1FL6 750W Motor



Siemens



Siemens



Siemens

Advantages

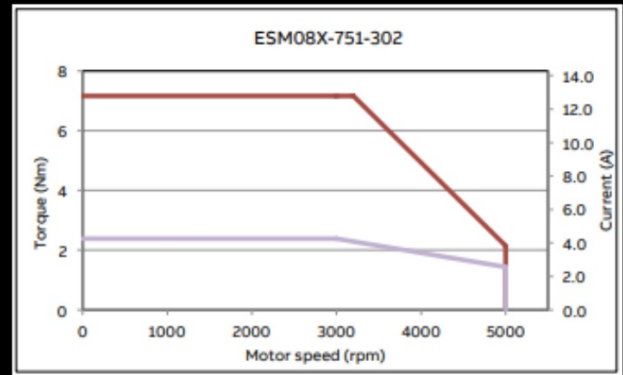
- PROFINET compatible
- Compatible with most existing CIM system hardware,
- Siemens PLC available,
- Familiarity with Software (TIA Portal),
- 2500 ppr incremental encoder,
- £835.60.

Siemens

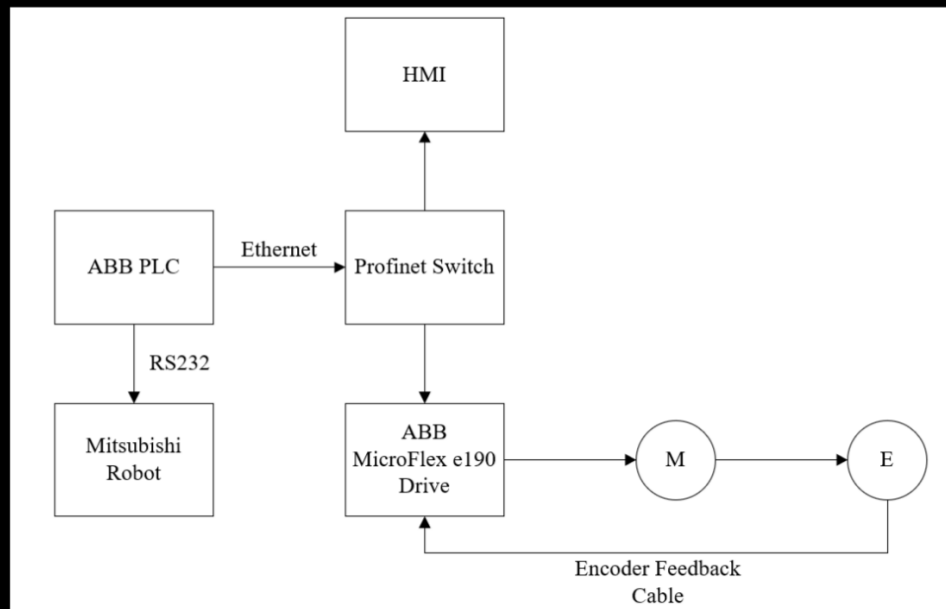
Disadvantages

- Less compatible with Mitsubishi robot.

ABB MicroFlex e190 Drive and e-Series 750W Motor



ABB



ABB

Advantages

- Possible future ABB replacement of Mitsubishi robot,
- PROFINET compatible.

ABB

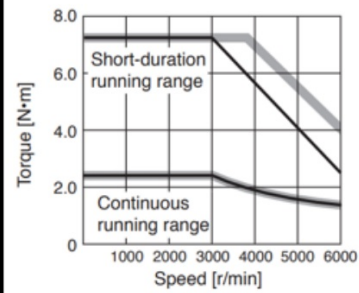
Disadvantages

- Absolute Encoder,
- Less compatible with existing system,
- New ABB PLC is required,
- £1214.40.

Mitsubishi Melservo J4 Drive and 750W Motor

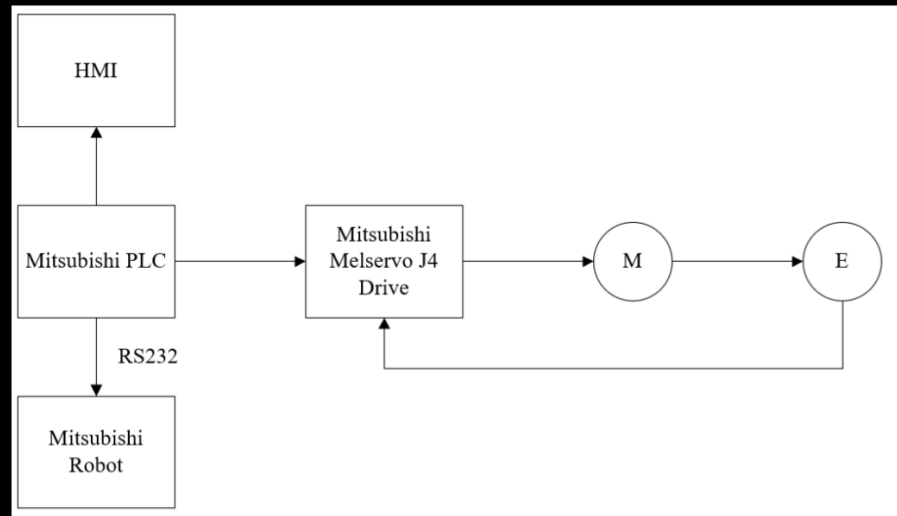


HG-MR73(B) (Note 1, 2)



- Notes: 1. — : For 3-phase 200 V AC or 1-phase 230 V AC.
2. — : For 1-phase 200 V AC.
3. Torque drops when the power supply voltage is below the specified value.

Mitsubishi



Mitsubishi

Advantages

- Ultra-low inertia,
- 4194304 ppr incremental encoder,
- Compatible with existing finishing robot.

Mitsubishi

Disadvantages

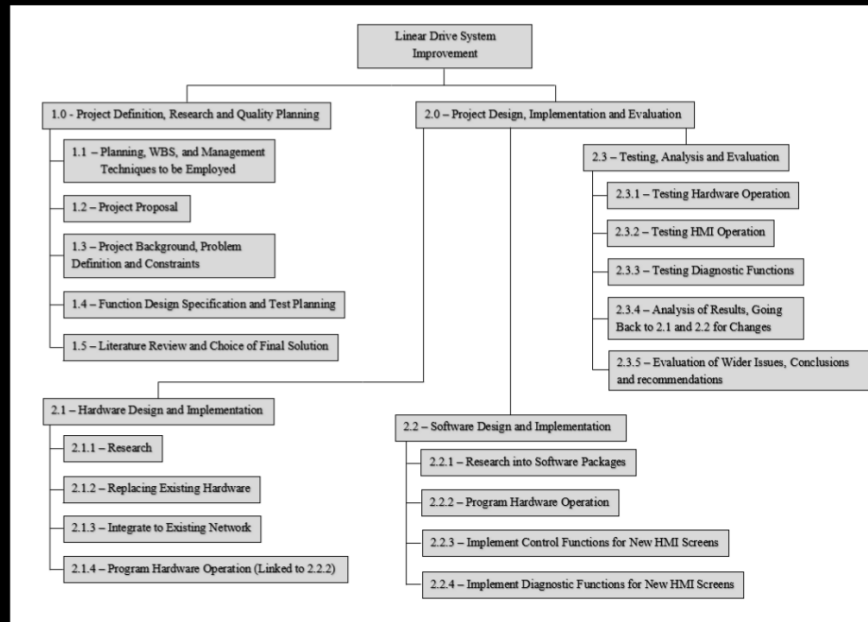
- Drive dimensions too large,
- Incompatible with rest of CIM system hardware,
- No PROFINET compatibility,
- New Mitsubishi PLC required,
- Soon to be outdated technology,
- £1651.50.

Chosen Solution and Justification

Siemens V90 Drive and s-1fl6 Servo Motor:

- Within Budget,
- Meets FDS requirements,
- Compatible with existing system and PROFINET network,

Project Planning and Management Techniques



Project Planning and Management Techniques

2019-2020	20/09/2019	27/09/2019	04/10/2019	11/10/2019	18/10/2019	25/10/2019	01/11/2019	08/11/2019	15/11/2019	22/11/2019	29/11/2019	06/12/2019	13/12/2019	20/12/2019	27/12/2019	03/01/2020	10/01/2020	17/01/2020	24/01/2020	31/01/2020	07/02/2020	14/02/2020	21/02/2020	28/02/2020	06/03/2020	13/03/2020	20/03/2020	27/03/2020	03/04/2020	10/04/2020	17/04/2020	24/04/2020	01/05/2020	08/05/2020	15/05/2020										
Week Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35										
Task																																													
Logbook																																			14										
Background Research																															11														
Planning, WBS and Management Techniques to be Employed					2																																								
Project Proposal				1																																									
Project Background, Problem Definition and Constraints						3																																							
Function Design Specification and Test Planning							4																																						
Literature Review									5																																				
Choice of Final Solution											6																																		
Interim Presentation													7																																
Design																			8																										
Implementation, Construction and Programming																						9																							
Testing, Results and Analysis																													12																
Commissioning																																10													
Project Evaluation																																					13								

Current Progress

- Ordered Siemens V90 drive and servo motor in preparation for design phase.
- Background research on V90 software.

6FX30022CT201AD0	V90 SIGNAL CABLE PRE-ASSEMBLED 3M	51.67	1	51.67
6FX30025CK011AD0	V90 POWER CABLE PRE-ASSEMBLED 3M	34.83	1	34.83
1FL60422AF211AA1	V90 SERVOMOTOR 2.39NM 3000RPM 230VAC	269.78	1	269.78
6SL32105FB108UF0	V90 SERVO DRIVE 0.75KW 230V 1/3PH PN	479.32	1	479.32
	Panel, Circuit Breakers, Trunking, Cabling	200	1	200
			Total	1035.6
			Remaining	64.4

FINAL GRADE

GENERAL COMMENTS

66/100

Instructor

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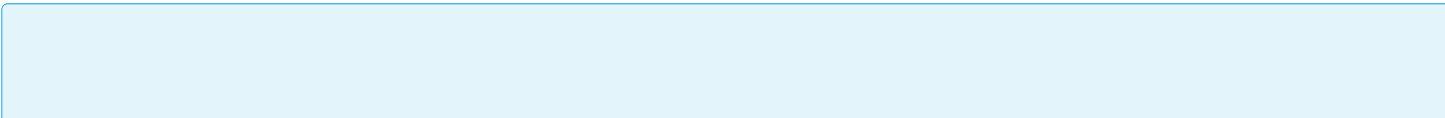
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1. ENGAGEMENT WITH LITERATURE

-  Engagement in research, for project background (/5) Good with references made to regulations. Evidence of research was demonstrated, particularly for wider issues such as ethical engineering. (4/5) Engagement in research, for review of solutions (/5) Good evidence through information provided. Limited evidence of this in the presentation due to running out of time. (3/5) Total = 7/10 **7**

2. KNOWLEDGE AND UNDERSTANDING

-  Project background (/5) Briefly discussed with sufficient detail to provide a clear understanding. Project explained as the addition of a robot to the existing CIM system at Coleg Sir Gar. (4/5) Project risks, health and safety etc (/5) Briefly described. Ethical engineering explained in some detail and a project risk chart was explained showing factors against the project success. (4/5) Response to questions 1, 4, 7 and 8 (/10) Good answers provided. Use of efficient components such as the motor and utilisation of Profi-Energy. (7/10) Total = 15/20 **15**

3. COGNITIVE AND INTELLECTUAL

-  Problem Definition and constraints (/10) Very good explanation given. Problem identified as poor positioning of the arm and low maximum speed. (7/10) Functional Design Specification (/10) Excellent. FDS explained including set speeds and use of interlock for safety. (8/10) Test planning (/10) Not provided in main presentation but explained after questioning. 7 step test included, however the metrics for assessing system performance were vague. (4/10) Response to questions 2 and 6 (/5) Good answers provided. Details of these questions were covered in the presentation itself. (4/5) Total = 22/35 **22**

4. PRACTICAL APPLICATION

-  Critical choice and justification of final solution (/10) Very good review and choice made. Ran out of time, so this was not explained in detail. Solutions were: Siemens V90, ABB or Mitsubishi. (6/10) Project Planning and working breakdown structure (/10) Briefly outlined and explained well. Evidence of planning through a simple Gantt chart and a WBS. (6/10) Response to questions 3 and 5 (/5) Good answers provided. Questions on code of conduct and management techniques were well answered. (3/5) Total = 15/25 **15**

5. TRANSFERABLE SKILLS

-  Quality of the presentation slides – (/5) Very good Most slides were generally readable and well presented, however there were far too many. (29 slides for a 10 minute presentation?) (3/5) Quality of the delivery style – (/5) Good style but over ran by 1.5 mins Confidently presented, too much time spent on ethical engineering meant little time to cover the technical aspects. (4/5) Total = 7/10 **7**