School of Electrical Engineering – University of Belgrade



# PROJECT MANAGEMENT AND LEADERSHIP SKILLS IN POWER ELECTRONICS RESEARCH ENGINEERING

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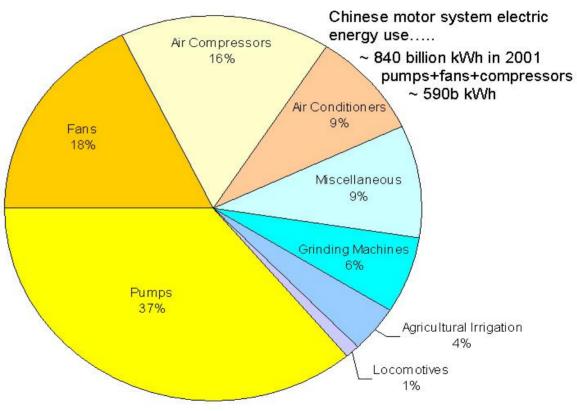
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Belgrade, 24<sup>th</sup> of October 2007

### **Outline:**

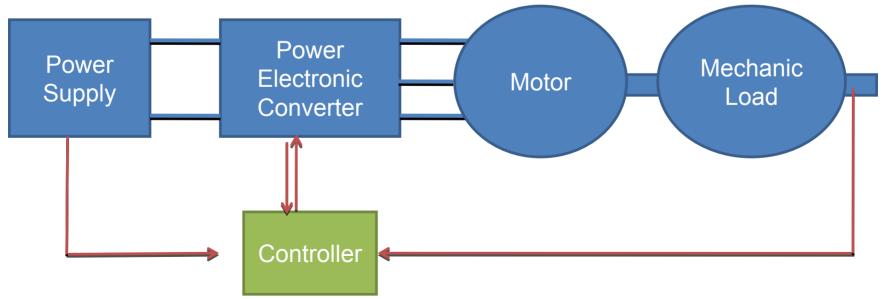
- **1. Fundamentals of Electrical Drives**
- 2. Typical Phases of the Projects in Power Electronics
- 3. The role of Project Managers and Team Leaders
- 4. Project methodology
- 5. Managing MiniDrive Power Electronics Project

- 50% of total electrical energy produced in developed countries is converted into mechanical energy by electric motors
- Electric motors consume more than 75% of all electrical power in the US
- Adjustable-speed motors can improve the efficiency of these motors by about 50% in many applications.



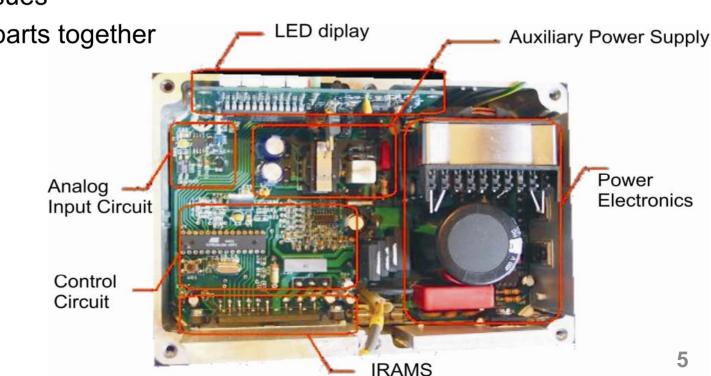
- A typical Adjustable-speed drive system consists of:
- Power Supply
- Power Electronic Converter
- Motor + Mechanical Load
- Controller

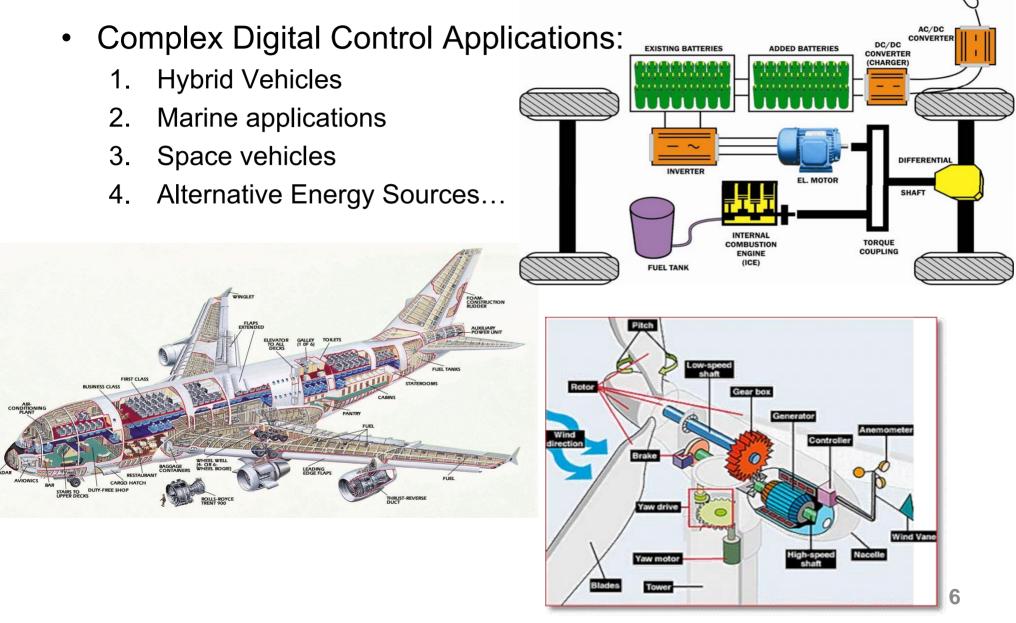




#### A typical adjustable-speed drive system

- Digital Control Applications:
  - Different Voltage levels
  - Communication among devices
  - Data converting (A/D & D/A conversions)
  - Programming
  - Thermal issues
  - Putting all parts together (soldering)
  - Testing...





### **Complexity of Projects in Power Electronics**

The requirements of the Power Electronics Projects are always the same:

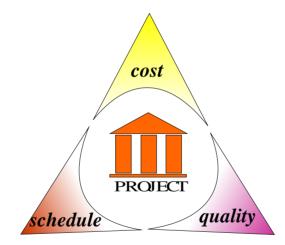
- More efficiency
- Less expanses and consumption
- Higher level of communication with other electrical devices
- Bigger working autonomy of devices etc.

Usually we need engineers from different field of expertise:

- Electronics
- Power
- Automation
- Software Design
- Communication
- Mechanical
- Material technology...

# Need for a Project Management

- Projects in electrical engineering are complex with a multitude of variables
- New application must often interface with many other applications
- Thereby, there is a need for creating an integration challenge that is difficult to estimate in both time and resources



All three corners of the Bermuda Triangle can be achieved on every project

# Project Leader's role

# Leaders must have a wide range of skills, techniques and strategies. These include:

- Planning
- Communication skills
- Organization
- Awareness of the wider environment in which the team operates
- Leaders' major role is to:
  - Set direction
  - Guide a vision

(have the strength of character to pursue their objectives in spite of failures)

- Establishes achievable goals
- Support team members
   (somebody might begin to lose confidence and therefore motivation)

### Project Manager's role

#### • Manager as a Planner.

A Manager has to take a long-term view; indeed, the higher you rise, the further you will have to look.

#### • Manager as a Provider.

The Manager has access to information and materials which the team needs.

#### Manager as a Protector.

The manager should be there to guard against short-term excitements which can deflect the work-force from the important issues of the project, and to protect the team.

- Managers' major role is to:
  - Do motivation
  - Define problems
  - Seek for solution
  - Delegate the job

# **Project Definition**

• A Project is a *temporary* endeavor undertaken to create a *unique* product or service.

#### Temporary:

Every project has a definite start and end that finishes with a final product *Unique*:

Every project is different in some distinguishing way, unique final product

#### Each project in electrical engineering starts with:

- **vision** final result of the project (product)
- mission process of making the final product
- **strategy** outline of the project

# **MiniDrive Project Definition**



- Future Energy Challenge Program Vision:
  - Encourage development of technologies to bring dramatic improvements to low-cost single-phase motor systems for home use
  - Incorporate practicality, manufacturability, and affordability into competition process
  - Improve education through development of innovative team-based solutions to complex problems
- Technical Goals:
  - Construct adjustable speed motor system costing less than US \$40 for a 500 W unit
  - Achieve maximum efficiency and operating requirements
  - Maintain acceptable levels of performance, reliability, and safety

# Starting with Project Specification

- A specification is a detailed definition of the project: <u>a statement of the problem, not the solution</u>.
- The agreement upon a written specification has several benefits:
  - the clarity will reveal misunderstandings
  - the completeness will remove contradictory assumptions
  - > the agreement forces all concerned to actually read and think about the details

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### MiniDrive Project Specification



#### **Design Specifications**

- Electrical noise FCC Class A
- Acoustic noise Less than 50 dBA sound level measured 0.5 m from the unit
- Self-protect against continuous stall, over temperature, or loss of input source
- Environment Ambient -20C to +40C; suitable for indoor or outdoor domestic applications.
- 10 years maintenance free
- < 8 kg for complete system</p>
- Metal casing must be connected to safety ground

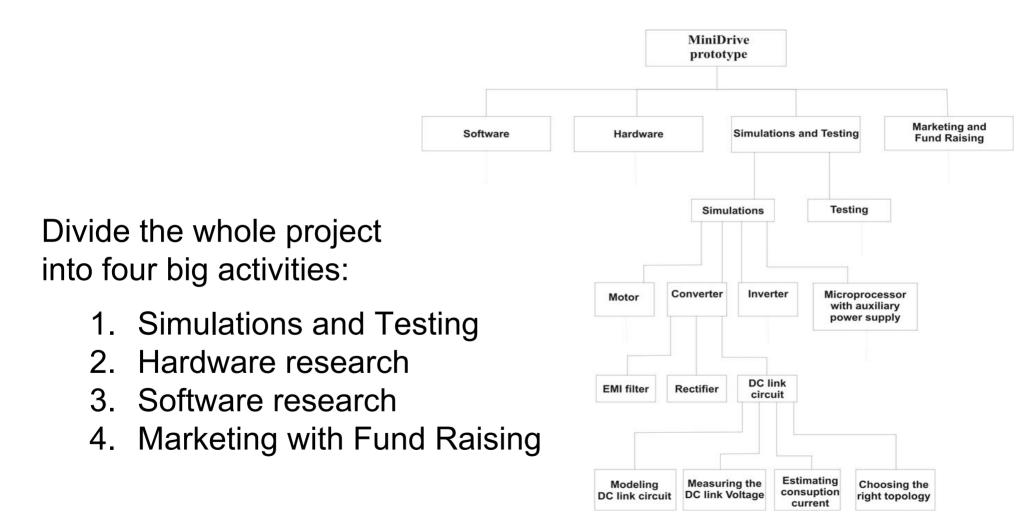
# **Providing Structure**



- After decided what is the specification, the next problem is to decide what the team actually needs to do, and how to do it.
- Providing some form of **framework**
- Once you have a clear understanding of the project, organize it as a set of simple tasks which together achieve the desired result
- In planning any project, it is needed to follow the same simple steps: if an item is too complicated to manage, it becomes a list of simpler items- *work breakdown structure*

### MiniDrive Structure





# Forming the right team of engineers

- Before much progress can be made, a core team needs to be formed
- Teams or sub-teams (groups) that are small enough to foster effective communication
- Cross-functional communication between groups
- To accomplish the project goals, it is necessary to choose right Leader



• One has to believe in the project and be ready to drive it forward

The job of the leader has three key components:

- Leading the overall effort ("Obsessed" Leader)
- Dealing with individuals working with team members, understanding styles, communication and listening, motivating and rewarding, managing and resolving conflicts etc.
- *Managing the work* planning, delegating, tracking...

# MiniDrive team of engineers



Activities are carried out by individuals, but planning usually starts with classifications!

- Few students (core team) that were *committed*
- Form the whole team (17 members) and divide it into 4 groups
- Communication between the groups *Team Meetings*
- Team building helps develop a true, committed team spirit
- Sharing results
- Present Progress and remind on Milestone



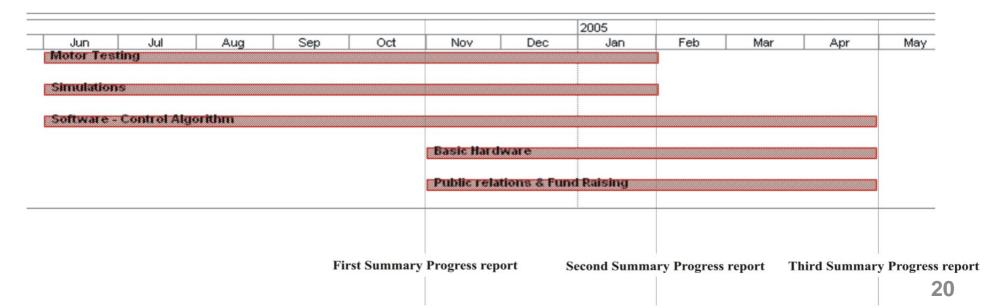
- The team must be involved in the planning of projects
- Not only they will provide information and ideas, but also they will feel ownership in the final plan
- Projects should be planned by leader and managers, based upon all the available experience and creative ideas
- With planning, projects can run on time and interact effectively with both customers and suppliers

### MiniDrive Planning

#### - Setting the Milestones -



- Take the main components and lay them out
- Assign critical dates and any key relationships (dependencies)
- Milestones are needed in order to control the progress of a project
  - External: Progress Reports (deadlines given by organizers)
  - Internal: Set with Advisor and Consultants



#### MiniDrive Gantt Chart



Instance     Data     Sum     Part     Part     Part     Part     Part     Part     Part       1     SUMLATON RESERACH     76 40     The 100 4     The 100 4     All       1     SUMLATON RESERACH     36 40     Mon 2004     The 100 4     All       1     SUMLATON RESERACH     36 40     Mon 2004     The 100 4     All       1     SUMLATON RESERACH     36 40     Mon 2004     Mon 2004     All       1     SUMLATON RESERACH     36 40     Mon 2004     Mon 2004     All       1     SUMLATON RESERACH     30 40     Mon 2004     Mon 2004     All       1     SUMLATON RESULTS     22 40     The 400     Mon 2004     All       1     SUMLATON RESULTS     32 40     The 400     Mon 2014     All       1     SUMLATON RESULTS     22 40     The 400     Mon 2014     All       1     SUMLATON RESULTS     23 40     The 4010     The 2014     All       1     SUMLATON RESULTS     24 40     The 4010     The 2014     All       1     SUMLATON RESULTS     24 40     The 4010     The 2014     All       1     SUMLATON RESULTS     24 40     The 4014     The 4014     All       1 <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>							
2SMULATION RESERACI78 days 40 (mo.2014)The 91/04A2.A13Mone Simulation33 daysThe 91/04Mo.104 (Mo.100, Mo.100, MO.	ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names
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4         converter simulation         33 days         Fue 0F104         Tur 3194         A2           5         invorter simulation of microgressor with auxiliary power supply         33 days         Mon 62104         Fit 32004         A1           6         invorter simulation         30 days         Mon 62104         Fit 32004         A1           7         MOTOR TESTING         32 days         Fit 91704         Mon 81004         A3           8         SIMULATION RESULTS         22 days         Fit 91704         Mon 81004         A3           9         DRVE TESTING         35 days         The 61704         Wed 91504         B1           10         AUXILARY PORE SUPPLY (APS)         55 days         The 71704         Wed 91504         B1           11         Generating the final Schematic for APS         85 days         Fit 101704         Wed 91504         B1           12         Generating the final Schematic for APS         85 days         Fit 101704         Wed 91504         B2           13         DE LINN CIRCUT         55 days         Fit 101704         Wed 9164         The 2005         B3           14         DE LINN CIRCUT         55 days         Fit 101704         Wed 9164         The 31565         B3      <	2	SIMULATION RESEARCH	78 days	Tue 6/1/04	Thu 9/16/04		A2,A1
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6     invoter simulation     30 days     Mon 92/104     Fit 73:004     At 74       7     MOTOR TESTING     33 days     Fit 917/204     Mon 19/180     34.5.0     At 74       8     DRIVE TESTING     33 days     The 07/104     Mon 19/180     34.5.0     At 74       8     DRIVE TESTING     33 days     The 07/104     Mod 19/180     10.2.9     At 74       1     ALXADWARE     22 days     The 07/104     Wed 4/1605     Hold 100     10.2.9     Bit 72       1     ALXADWARE     22 days     The 7/104     Wed 4/1504     Hold 100     10.2.9     Bit 72     Bit 72       1     ALXADWARE     26 days     The 7/104     Wed 4/1504     Hold 100     10.2.9     Bit 72     Bit 72       1     Buck converter analyzis     85 days     The 7/104     Wed 9/164     To 2/102     Bit 72     Bit 72       1     Buck converter analyzis     80 days     Wed 9/164     To 2/102     10.2.9     Bit 72     Bit 72 <t< td=""><td>4</td><td>converter simulation</td><td>33 days</td><td>Tue 6/1/04</td><td>Thu 7/15/04</td><td></td><td>A2</td></t<>	4	converter simulation	33 days	Tue 6/1/04	Thu 7/15/04		A2
P     MOTOR TESTING     44 days     The 6100     Fit 917004     Mon 101800     3.4.5       B     SIMULATION RESULTS     22 days     Fit 91704     Mon 101800     3.4.5       D     21 HARDWARE     22 days     The 6100     Mon 2100     1.2.9     A.1.4       D     21 HARDWARE     272 days     The 6100     Mon 2100     1.2.9     A.1.4       D     21 HARDWARE     272 days     The 6100     Mon 2100     1.2.9     A.1.4       D     ALIARY DWER SUPPLY (APS)     56 days     Thu 7104     Wed 91054     1.2.9     1.2.9       D     Generating the final Schematic for APS     88 days     Fit 101704     Wed 91064     1.2.2105     1.3.2     1.3.2       D     Generating the final Schematic for APS     88 days     Fit 1017504     Thu 2100     1.3.2     1.3.2       D     Generating the final Schematic for APS     88 days     Fit 1017504     Thu 2109     1.3.2     1.3.2       D     Generating PFC     78 days     Thu 71504     Thu 2109     1.3.2     1.3.2       D     Chark Clutt     Fit 017504     Thu 2109     1.3.2     1.3.2       D     Chark Clutt     Fit 010750     Thu 2109     1.3.2     1.3.2       D     Chark Clutt <td< td=""><td>5</td><td>simulation of microprocessor with auxiliary power supply</td><td>23 days</td><td>Mon 8/2/04</td><td>Wed 9/1/04</td><td></td><td>A1</td></td<>	5	simulation of microprocessor with auxiliary power supply	23 days	Mon 8/2/04	Wed 9/1/04		A1
8     SINULATION RESULTS     22 days     FIG 9704     Mon 101200 3.4.5.5     A       9     2. HARDWARE     32 days     The 61106     Mon 20120     A.3.1       11     AUXILARY FORESUPPLY (APS)     72 days     The 61104     Med 61508     B162       12     AUXILARY FORMER SUPPLY (APS)     56 days     Thu 71104     Wed 91504     B162       13     Buck converter analyzis     56 days     Thu 71104     Wed 91504     B162       14     Generating the find Schematic for APS     86 days     The 17104     Tue 27105     B1.2       15     HVERTER     00 days     Wed 91104     Tue 27106     B1.2       15     HVERTER     00 days     Wed 91104     Tue 172704     B3.64       16     HOC LINK CIRCUT     Tue 3700     Tue 17404     Tue 17404     B3.64       17     Examine the Standards     28 days     Tue 61104     Tue 17406     Tue 17406     B3.64       16     HOC LINK CIRCUT     Tue 41104     Tue 91104     Tue 91104     B3.64       16     HIMER     44 days     Tue 61106     HIMER     B3.64       16     HIMER     43 days     Tue 61104     Tue 31105     B4.64       16     HIMER     HIMER     HIMER     B4.64     <	6	inverter simulation	30 days	Mon 6/21/04	Fri 7/30/04		A1
9     DRW TESTING     33 days     Thu 61005     Mon 61/105     10.29     AJA1       10     2.1 ARDWARE     272 days     Tue 61/104     Wed 61/505     BL2       11     AUXLARY POWER SUPPLY (APS)     56 days     Thu 71/104     Wed 91/504     B1       12     Pyback converter analyzis     56 days     Thu 71/104     Wed 91/504     Wed 91/504     B1       12     Generating the final Schematic for APS     86 days     Fin 10/104     Tue 21/05     B1,82       13     Generating the Standards     26 days     Wed 91/504     Tue 21/05     B1,82       14     Generating PFC     110 days     Wed 91/504     Tue 21/05     B3,63       14     Generating PFC     78 days     Fin 10/104     B5,84       15     GOL MK CIPCOUT     36 days     Tue 61/104     Hint     B5,84       14     Generating PFC     78 days     Tue 61/104     Hint     B5,84       15     GOL MK CIPCOUT     36 days     Tue 61/104     Hint     B5,84       16     Generating PFC     16 days     Tue 61/104     Hint     B5,84       16     GENTROL CRUE IN FINCE     16 days     Tue 61/104     Hint     B5,84       16     GENTROL CRUE IN FINCE INTER COMPONENTS     16 days	7	MOTOR TESTING	44 days	Tue 6/1/04	Fri 7/30/04		A3
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16PFC110 daysWed 9/104Tue 2/105BS17Examine the Standards28 daysWed 9/104Fr1 0/15046518Generating PFC76 daysFr1 0/1504Wed 9/1046619DC LINK CIRCUIT35 daysThr 0/1504Wed 9/1046620RECTFIER & EMI FILTER206 daysTue 6/104Wed 9/1046821rectifier44 daysMon 1/1705BS8622EMI filter42 daysMon 1/1705Tue 3/15058423CONTROL CIRCUIT & PROTECTION45 daysMon 1/1705Mon 3/1058424TERMIC DESIGN15 daysMon 5/205Fri 8/200616,19,15,118425CHOOSING THE COMPONENTS11 daysWed 6/1604Wed 6/15058426CHOOSING THE ELEMENTS ONTO THE PRINTING BOARD11 daysWed 6/1604Wed 6/15058427ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD11 daysWed 6/1604Wed 6/150516,22,2328OFTWARE295 daysTue 6/164Fri 6/1005C1,22,2429PROGRAMMING255 daysTue 6/164Fri 6/1005C1,22,2429OCONTABLETING BOARD14 daysTue 1/1514C1,22,2429PROGRAMMING256 daysTue 6/164Fri 6/1005C1,22,2420CONTABLETING BOARD256 daysTue 1/1514C1,22,2421OCONTABLETING BOARD256 daysTue 1/1514C1,22,2423O	14	Generating the final Schematic for APS	88 days	Fri 10/1/04	Tue 2/1/05	13,12	B1,B2
Image: Control and problems         Rest and problems <threst and="" problems<="" th="">         Rest and problems<!--</td--><td>15</td><td>INVERTER</td><td>60 days</td><td>Wed 9/15/04</td><td>Tue 12/7/04</td><td>19</td><td>B3,B4</td></threst>	15	INVERTER	60 days	Wed 9/15/04	Tue 12/7/04	19	B3,B4
18Generating PFC78 daysFri 10/1504Tue 2/105 178519DC LINK CIRCUIT35 daysTub 17/1504Weld 9/1046620RECTFIER & EM FILTER26 daysTue 6/104Fri 7/300485,421rectfiler44 daysTue 6/104Fri 7/30048622EMI filter42 daysMon 1/1705Tue 3/150581,423CONTROL CIRCUIT & PROTECTION54 daysMon 1/1705Tue 3/150582,424TERMIC DESIGN15 daysMon 1/1705Tue 3/150584,425CHOOSING THE COMPONENTS34 daysFri 4/105Tue 5/310,584,426PROGRAMING11 daysWeld 6/1604Weld 6/300,486,427ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD11 daysWeld 6/160,4Weld 6/300,486,4283. SOFTWARE259 daysTue 6/150,4Fri 6/100,5C1,C2,C329Ontorial algorithm259 daysTue 6/150,4Fri 6/100,5C1,C2,C331A/D conversion and protection56 daysMon 1/170,4Mod 1/170,4C1,C2,C332Protections64 daysTue 3/150,5Fri 4/290,5C1,C2,C333LED Display24 daysTue 3/150,5Fri 4/290,5C1,C2,C334Diglial Communication64 daysTue 3/150,5Fri 4/290,5C1,C2,C335Protections64 daysTue 3/150,5Fri 4/290,5C1,C2,C336MAKING THE PROJECT ORIENTED INTERFACE </td <td>16</td> <td>PFC</td> <td>110 days</td> <td>Wed 9/1/04</td> <td>Tue 2/1/05</td> <td></td> <td>B5</td>	16	PFC	110 days	Wed 9/1/04	Tue 2/1/05		B5
19DC LINK CIRCUIT35 daysThu 7/1504Wed 9/1049620RECTIFIER & EMI FILTER206 daysTue 6/1/04Tue 3/150585,8421rectifier44 daysTue 6/1/04AF.//30/048022EMI filter42 daysMon 1/1705Tue 3/15058423CONTROL CIRCUIT & PROTECTION54 daysMon 1/1705Tue 3/150516,19,15,1124TENICI DESIGN16 daysMon 1/1705Tue 5/31058425CHOOSING THE COMPONENTS43 daysFri 4/105Tue 5/31058426PRINTING BOARD11 daysWed 6/104Wed 6/15068627ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD11 daysWed 6/164Wed 6/15068628SOFTWARE259 daysTue 6/1504Fri 6/1005C1,62,C329PROGRAMMING259 daysTue 6/1504Fri 6/1005C1,62,C331A/D conversion and protection56 daysMon 8/1604Mon 11/104C332LED Display45 daysTue 3/1505Fri 4/2905C1,C2,C334Digital Communication54 daysTue 3/1505Fri 4/2905C1,C2,C335Monturination54 daysTue 3/1505Fri 4/2905C1,C2,C336MC BLED DisplayG4 daysTue 3/1505Fri 4/2905C1,C2,C3374. MARKETINGSt daysTue 3/1505Fri 4/2905C1,C2,C338MC BLED DisplayG4 daysTue 2/1505Fri 4/29	17	Examine the Standards	28 days	Wed 9/1/04	Fri 10/8/04		B5
20RECTIFIER & EMI FILTER206 dayTue 6/1/04Tue 3/1505B5,B421roctifier44 daysTue 6/1/04Fri 7/3004B522EMI filter42 daysMon 1/1705Tue 3/1505B423CONTROL CICULT & PROTECTION42 daysMon 1/1705Tue 3/1505B524TERMIC DESIGN15 daysMon 5/205Fri 5/200516,19,15,11B425CHOOSING THE COMPONENTS43 daysFri 4/1/05Tue 6/1504B426PRINTING BOARD11 daysWed 6/1604Wed 6/3004B427ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD11 daysWed 6/1604Wed 6/3004B428S. OFORGAMMING259 daysTue 6/1504Fri 6/1005C1,C2,C329Oontrol algorithm259 daysTue 6/1504Fri 6/1005C1,C2,C330Control algorithm56 daysTur 6/1504G1G331ALD Conversion and protection56 daysTue 3/1505G1,C2,C333GLED Display24 daysTue 3/1505C1,C2,C3G134Diglal Communication54 daysTue 3/1505C1,C2,C335Protections64 daysTue 3/1505C1,C2,C3G134Diglal Communication54 daysTue 3/1505C1,C2,C335Protections64 daysTue 3/1505C1,C2,C3G136ALED DisplayG1G1G1G237ANARKETINFG3G4	18	Generating PFC	78 days	Fri 10/15/04	Tue 2/1/05	17	B5
21rectifier44 daysTue 61/104Fri 7/30/4Bri22EMI filter42 daysMon 1/1705Tue 3/1505B423CONTROL CIRCUIT & PROTECTION54 daysMon 1/1705Thu 3/3105B524TERMIC DESION15 daysMon 5/20516,19,15,11B425CHOOSING THE COMPONENTS43 daysFri 4/105Tue 5/3105B426PRINTING BOARD11 daysWed 6/105Wed 6/30/4B427ASSEMBLING RE ELEMENTS ONTO THE PRINTING BOARD11 daysWed 6/1504Wed 6/30/4B428SOFTWARE259 daysTue 6/1504Fri 6/1005Tue 2/105Tue 2/10529PROGRAMMING259 daysTue 6/1504Fri 6/1005C1,C2,C330control algorithm259 daysTue 6/1504Fri 6/1005C1,C2,C331ADD conversion and protection66 daysTue 3/105Fri 4/1205C1,C2,C332PWM signali45 daysTue 3/105Fri 4/29/05C1,C2,C333LED Display45 daysTue 3/105Fri 4/29/05C1,C2,C334Objeita Communication64 daysTue 3/105Fri 4/29/05C1,C2,C335Protections64 daysTue 3/105Fri 4/29/05C1,C2,C336REALLZATION OF OBLECT ORIENTED INTERFACE54 daysTue 3/105Fri 4/29/05C1,C2,C337AMAKETINGGALECT23 daysTue 6/104Sun 9/25/05C138MALLATION OF OBLECT O	19	DC LINK CIRCUIT	35 days	Thu 7/15/04	Wed 9/1/04		B6
22EMI filter42 daysMon 1/17/05Tue 3/1505B423CONTROL CIRCUIT & PROTECTION54 daysMon 1/17/05Thu 3/31055524TERMIC DESIGN15 daysMon 5/205Fri 5/2005 16, 19, 15, 11B425CHOOSING THE COMPONENTS14 daysMod 5/205Fri 5/2005 16, 19, 15, 11B426PRINTING BOARD11 daysWed 6/105Wed 6/1505B427ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD11 daysWed 6/1604Wed 6/3004B428JOSTWARE259 daysTue 6/15/04Fri 6/1005TUE 2/229PROGRAMMING259 daysTue 6/15/04Fri 6/1005C1/2C,2330control algorithm259 daysTue 6/15/04Fri 6/1005C1/2C,2331ADD conversion and protection259 daysTue 3/15/05Fri 4/15/05C1/2C,2332PWM signali45 daysThu 2/15/05Fri 4/15/05C1/2C,2333LED Display24 daysTue 2/15/05Fri 4/15/05C1/2C,2334Digital Communication24 daysTue 2/15/05Fri 4/15/05C235Protections64 daysTue 2/15/05Fri 4/15/05C236MAKING THE PROJECT34 daysTue 3/10/5Fri 5/13/05C2374.MARETINGMAKING THE PROJECT23 daysTue 6/10/4Mon 11/15/04D138MAKING THE PROJECT23 daysTue 6/10/4Mon 11/15/04D239WEB SITE	20	RECTIFIER & EMI FILTER	206 days	Tue 6/1/04	Tue 3/15/05		B5,B4
23         CONTROL CIRCUIT & PROTECTION         54 days         Mon 1/17/05         Thu 3/31/05         B5           24         TERMIC DESIGN         15 days         Mon 5/2/05         Fri 5/20/05 16,19,15,11         B4           25         CHOOSING THE COMPONENTS         43 days         Fri 4/1/05         Tue 5/31/05         B4           26         PRINTING BOARD         11 days         Wed 6/16/04         Wed 6/30/04         B6           27         ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD         11 days         Wed 6/16/04         Wed 6/30/04         B6           28         3.SOFTWARE         259 days         Tue 6/15/04         Fri 6/10/05         C1,C2,C3           29         PROGRAMMING         259 days         Tue 6/15/04         Fri 6/10/05         C1,C2,C3           31         A/D conversion and protection         56 days         Mon 8/16/04         Mon 11/1/04         C1,C2           32         PWM signali         45 days         Tuu 2/1/05         Fri 4/29/05         C1,C2,C3           33         LED Display         24 days         Tuu 2/1/05         Fri 4/129/05         C1,C2           34         Digital Communication         56 days         Tuu 2/1/05         Fri 4/129/05         C2           35	21	rectifier	44 days	Tue 6/1/04	Fri 7/30/04		B5
4         TERMIC DESIGN         15 days         Mon 5/2/05         Fri 5/2/005         16, 19, 15, 11         B4           25         CHOOSING THE COMPONENTS         43 days         Fri 4/1/05         Tue 5/31/05         B4           26         PRINTING BOARD         11 days         Wed 6/1/05         Wed 6/105         B4           27         ASSEMBLING THE LEMENTS ONTO THE PRINTING BOARD         11 days         Wed 6/16/04         Wed 6/10/05         B4           28         3. SOFTWARE         259 days         Tue 6/15/04         Fri 6/10/05         C1.2,C3           29         PROGRAMMING         259 days         Tue 6/15/04         Fri 6/10/05         C1.2,C3           31         Octortol algorithm         259 days         Tue 6/15/04         Fri 6/10/05         C1.2,C3           32         Optod signali         45 days         Thu 7/1/04         Wed 9/1/04         C3           33         LED Display         24 days         Tue 2/1/505         Fri 4/15/05         C1.2,C3           34         Digital Communication         54 days         Tue 2/1/05         Fri 4/12/05         C1.2,C3           35         Protections         G1         C4         S4         Tue 2/1/05         Fri 4/12/05         C1.2,C3	22	EMI filter	42 days	Mon 1/17/05	Tue 3/15/05		B4
25         CHOOSING THE COMPONENTS         43 days         Fri 4/1/05         Tue 5/31/05         B4           26         PRINTING BOARD         11 days         Wed 6/1/05         Wed 6/1/05         B4           27         ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD         11 days         Wed 6/1/04         Wed 6/3/04         B6           28         3. SOFTWARE         259 days         Tue 6/15/04         Fri 6/1005            29         PROGRAMMING         259 days         Tue 6/15/04         Fri 6/1005          C1,C2,C3           31         A/D conversion and protection         56 days         Mon 8/16/04         Mon 11/1/04         C1,C2,C3           32         Demolaginithm         259 days         Tue 6/15/04         Fri 6/1005         C1,C2,C3           33         LED Display         24 days         Tue 3/15/05         Fri 4/15/05         C1,C2           34         Digital Communication         54 days         Tue 2/15/05         Fri 4/29/05         C1           35         Protections         64 days         Tue 2/15/05         Fri 4/29/05         C2           36         MAKING THE PROJECT         23 days         Tue 6/1/04         Sun 9/25/05         C1           38         MAK	23	CONTROL CIRCUIT & PROTECTION	54 days	Mon 1/17/05	Thu 3/31/05		B5
26         PRINTING BOARD         11 days         Wed 6/1/05         Wed 6/15/05         B4           27         ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD         11 days         Wed 6/16/04         Wed 6/30/04         B6           28         3. SOFTWARE         259 days         Tue 6/15/04         Fri 6/10/05         Fri 6/10/05           29         PROGRAMMING         Control algorithm         259 days         Tue 6/15/04         Fri 6/10/05         C1,C2,C3           30         control algorithm         259 days         Mon 8/16/04         Mon 11/1/04         C1,C2,C3           31         A/D conversion and protection         256 days         Mon 8/16/04         Mon 11/1/04         C1,C2,C3           32         DED Display         24 days         Tue 3/15/05         Fri 4/15/05         C1,C2,C3           33         LED Display         24 days         Tue 3/15/05         Fri 4/29/05         C1,C2           34         Digital Communication         54 days         Tue 3/1/05         Fri 4/29/05         C1,C2           35         Protections         64 days         Tue 3/1/05         Fri 4/29/05         C2           36         REALIZATION OF OBJECT ORIENTED INTERFACE         54 days         Tue 6/1/04         Sun 9/25/05         C2 <td>24</td> <td>TERMIC DESIGN</td> <td>15 days</td> <td>Mon 5/2/05</td> <td>Fri 5/20/05</td> <td>16,19,15,11</td> <td>B4</td>	24	TERMIC DESIGN	15 days	Mon 5/2/05	Fri 5/20/05	16,19,15,11	B4
27ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD11 daysWed 6/10/40Wed 6/30/4B6283. SOFTWARE259 daysTue 6/15/04Fri 6/10/052929PROGRAMMING259 daysTue 6/15/04Fri 6/10/051.0.2.2.330control algorithm259 daysTue 6/15/04Mon 1/1/040.1.0.2.2.331A/D conversion and protection259 daysMon 8/16/04Mon 1/1/040.1.0.2.2.332PWM signali45 daysTue 3/15/05Fri 4/15/050.1.0.233LED Display24 daysTue 3/15/05Fri 4/15/050.1.0.234Digital Communication54 daysTue 2/15/05Fri 4/29/050.1.0.235Protections64 daysTue 2/15/05Fri 4/29/050.236REALIZATION OF OBJECT ORIENTER INTERFACE54 daysTue 2/15/05Fri 4/29/050.2374. MARKETING344 daysTue 6/1/04Sun 9/25/051.038MAKING THE PROJECT23 daysTue 6/1/04Tun 1/1/04D139WEB SITE11 daysTue 6/1/04Mon 11/15/04D241external11 daysTue 6/1/04Mon 11/15/040.242PUBLIC RELATIONS190 daysMon 1/3/05Sun 9/25/05D3	25	CHOOSING THE COMPONENTS	43 days	Fri 4/1/05	Tue 5/31/05		B4
28         3. SOFTWARE         259 days         Tue 6/15/04         Fri 6/10/05           29         PROGRAMMING         259 days         Tue 6/15/04         Fri 6/10/05         C1,C2,C3           30         control algorithm         259 days         Tue 6/15/04         Mon 11/10/4         C1,C2,C3           31         A/D conversion and protection         56 days         Mon 8/16/04         Mon 11/10/4         C1,C2,C3           32         DWM signali         C3         C4 days         Tue 3/15/05         C1,C2,C3           33         LED Display         C4 days         Tue 3/15/05         C1,C2           34         Digital Communication         24 days         Tue 3/15/05         Fri 4/29/05         C1,C2           35         Protections         64 days         Tue 2/15/05         Fri 4/29/05         C1           35         Protections         64 days         Tue 2/16/05         Fri 5/13/05         C2           36         REALIZATION OF OBJECT ORIENTED INTERFACE         54 days         Tue 6/1/04         Sun 9/25/05         C2           37         A. MARKETING         23 days         Tue 6/1/04         Thu 7/1/04         D1           38         MAKING THE PROJECT         23 days         Tue 6/1/04         <	26	PRINTING BOARD	11 days	Wed 6/1/05	Wed 6/15/05		B4
PROGRAMMING259 daysTue 6/15/04Fri 6/10/05C1,C2,C330control algorithm259 daysTue 6/15/04Fri 6/10/05C1,C2,C331A/D conversion and protection56 daysMon 8/16/04Mon 11/10/4C1,C232PWM signali45 daysThu 7/1/04Wed 9/1/04C333LED Display24 daysTue 3/15/05Fri 4/15/05C1,C234Digital Communication54 daysTue 2/15/05Fri 4/29/05C135Protections64 daysTue 2/15/05Fri 4/29/05C236REALIZATION OF OBJECT ORIENTED INTERFACE54 daysTue 2/105Fri 5/13/25/05C2374. MARKETINGStat daysTue 6/1/04Sun 9/25/05T39WEB SITE120 daysTue 6/1/04Mon 11/15/04D240internal11 daysTue 6/1/04Tue 6/1/04D241external34 daysWed 9/29/04Mon 11/15/0438D242PUBLIC RELATIONS190 daysMon 13/05Sun 9/25/05D3	27	ASSEMBLING THE ELEMENTS ONTO THE PRINTING BOARD	11 days	Wed 6/16/04	Wed 6/30/04		B6
30control algorithm259 daysTue 6/15/04Fri 6/10/05C1,C2,C331A/D conversion and protection56 daysMon 8/16/04Mon 11/1/04C1,C232PWM signali45 daysThu 7/104Wed 9/1/04C333LED Display24 daysTue 3/15/05Fri 4/15/05C1,C234Digital Communication54 daysTue 2/15/05Fri 4/29/05C135Protections64 daysTue 2/15/05Fri 4/29/05C236REALIZATION OF OBJECT ORIENTED INTERFACE54 daysTue 2/1/05Fri 4/29/05C2374. MARKETING344 daysTue 3/100Fri 1/10/4D139WEE SITE23 daysTue 6/1/04Mon 11/15/04D240internal11 daysTue 6/1/04Mon 11/15/04D241external34 daysWed 9/2/04Mon 11/15/0438D242PUBLIC RELATIONS190 daysMon 13/05Sun 9/25/05D3	28	3. SOFTWARE	259 days	Tue 6/15/04	Fri 6/10/05		
31       A/D conversion and protection       56 days       Mon 8/16/04       Mon 11/1/04       C1,C2         32       PWM signali       45 days       Thu 7/1/04       Wed 9/1/04       C3         33       LED Display       24 days       Tue 3/15/05       Fri 4/15/05       C1,C2         34       Digital Communication       54 days       Tue 2/15/05       Fri 4/29/05       C1         35       Protections       64 days       Tue 2/1/05       Fri 4/29/05       C2         36       REALIZATION OF OBJECT ORIENTED INTERFACE       54 days       Tue 3/1/05       Fri 5/13/05       C2         37       4. MARKETING       344 days       Tue 6/1/04       Sun 9/25/05       C1         39       WEB SITE       23 days       Tue 6/1/04       Thu 7/1/04       D1         39       WEB SITE       11 days       Tue 6/1/04       Mon 11/15/04       D2         40       internal       11 days       Tue 6/1/04       Mon 11/15/04       D2         41       external       34 days       Wed 9/29/04       Mon 11/15/04       38       D2         42       PUBLIC RELATIONS       190 days       Mon 1/3/05       Sun 9/25/05       D3	29	PROGRAMMING	259 days	Tue 6/15/04	Fri 6/10/05		
32PWM signali45 daysThu 7/1/04Wed 9/1/04C333LED Display24 daysTue 3/15/05Fri 4/15/05C1,C234Digital Communication54 daysTue 2/15/05Fri 4/29/05C135Protections64 daysTue 2/105Fri 4/29/05C236REALIZATION OF OBJECT ORIENTED INTERFACE54 daysTue 3/105Fri 5/13/05C2374. MARKETING344 daysTue 6/1/04Sun 9/25/05T38MAKING THE PROJECT23 daysTue 6/1/04Thu 7/1/04D139WEB SITE120 daysTue 6/1/04Mon 11/15/04D241external11 daysTue 6/1/04Mon 11/15/0438D242PUBLIC RELATIONS190 daysMon 13/05Sun 9/25/05D3D3	30	control algorithm	259 days	Tue 6/15/04	Fri 6/10/05		C1,C2,C3
33         LED Display         24 days         Tue 3/15/05         Fri 4/15/05         C1,C2           34         Digital Communication         54 days         Tue 2/15/05         Fri 4/29/05         C1           35         Protections         64 days         Tue 2/1/05         Fri 4/29/05         C2           36         REALIZATION OF OBJECT ORIENTED INTERFACE         54 days         Tue 3/1/05         Fri 5/13/05         C2           37         4. MARKETING         Sun 9/25/05         Tue 6/1/04         Sun 9/25/05         Tue 6/1/04         D1           38         MAKING THE PROJECT         23 days         Tue 6/1/04         Mon 11/15/04         D1           39         WEB SITE         11 days         Tue 6/1/04         Mon 11/15/04         D2           40         internal         11 days         Tue 6/1/04         Mon 11/15/04         D2           41         external         34 days         Wed 9/29/04         Mon 11/15/04         D2           42         PUBLIC RELATIONS         190 days         Mon 13/05         Sun 9/25/05         D3	31	A/D conversion and protection	56 days	Mon 8/16/04	Mon 11/1/04		C1,C2
34         Digital Communication         54 day         Tue 2/15/05         Fri 4/29/05         C1           35         Protections         64 days         Tue 2/1/05         Fri 4/29/05         C2           36         REALIZATION OF OBJECT ORIENTED INTERFACE         54 days         Tue 3/1/05         Fri 5/13/05         C2           37         4. MARKETING         344 days         Tue 6/1/04         Sun 9/25/05         C1           38         MAKING THE PROJECT         23 days         Tue 6/1/04         Mon 11/15/04         D1           39         WEB SITE         120 days         Tue 6/1/04         Mon 11/15/04         D2           40         internal         11 days         Tue 6/1/04         Tue 6/15/04         D2           41         external         34 days         Wed 9/29/04         Mon 11/15/04         38         D2           42         PUBLIC RELATIONS         190 days         Mon 1/3/05         Sun 9/25/05         D3	32	PWM signali	45 days	Thu 7/1/04	Wed 9/1/04		C3
35         Protections         64 days         Tue 2/1/05         Fri 4/29/05         C2           36         REALIZATION OF OBJECT ORIENTED INTERFACE         54 days         Tue 3/1/05         Fri 5/13/05         C2           37         4. MARKETING         344 days         Tue 6/1/04         Sun 9/25/05         C2           38         MAKING THE PROJECT         23 days         Tue 6/1/04         Thu 7/1/04         D1           39         WEB SITE         120 days         Tue 6/1/04         Mon 11/15/04         D2           40         internal         11 days         Tue 6/1/04         Tue 6/15/04         D2           41         external         34 days         Wed 9/29/04         Mon 11/15/04         38           42         PUBLIC RELATIONS         190 days         Mon 1/3/05         Sun 9/25/05         D3	33	LED Display	24 days	Tue 3/15/05	Fri 4/15/05		C1,C2
36         REALIZATION OF OBJECT ORIENTED INTERFACE         54 days         Tue 3/1/05         Fri 5/13/05         C2           37         4. MARKETING         344 days         Tue 6/1/04         Sun 9/25/05         C2           38         MAKING THE PROJECT         23 days         Tue 6/1/04         Thu 7/1/04         D1           39         WEB SITE         120 days         Tue 6/1/04         Mon 11/15/04         D2           40         internal         11 days         Tue 6/1/04         Tue 6/15/04         D2           41         external         34 days         Wed 9/29/04         Mon 11/15/04         38         D2           42         PUBLIC RELATIONS         190 days         Mon 1/3/05         Sun 9/25/05         D3	34	Digital Communication	54 days	Tue 2/15/05	Fri 4/29/05		C1
374. MARKETING344 dayTue 6/1/04Sun 9/25/0538MAKING THE PROJECT23 daysTue 6/1/04Thu 7/1/04D139WEB SITE120 daysTue 6/1/04Mon 11/15/04D240internal11 daysTue 6/1/04Tue 6/15/04D241external34 daysWed 9/29/04Mon 11/15/04 38D242PUBLIC RELATIONS190 daysMon 1/3/05Sun 9/25/05D3	35	Protections	64 days	Tue 2/1/05	Fri 4/29/05		C2
38         MAKING THE PROJECT         23 days         Tue 6/1/04         Thu 7/1/04         D1           39         WEB SITE         120 days         Tue 6/1/04         Mon 11/15/04         D2           40         internal         11 days         Tue 6/1/04         Tue 6/15/04         D2           41         external         34 days         Wed 9/29/04         Mon 11/15/04 38         D2           42         PUBLIC RELATIONS         190 days         Mon 1/3/05         Sun 9/25/05         D3	36	REALIZATION OF OBJECT ORIENTED INTERFACE	54 days	Tue 3/1/05	Fri 5/13/05		C2
39         WEB SITE         120 days         Tue 6/1/04         Mon 11/15/04         D2           40         internal         11 days         Tue 6/1/04         Tue 6/15/04         D2           41         external         34 days         Wed 9/29/04         Mon 11/15/04 38         D2           42         PUBLIC RELATIONS         190 days         Mon 1/3/05         Sun 9/25/05         D3	37	4. MARKETING	344 days	Tue 6/1/04	Sun 9/25/05		
40       internal       11 days       Tue 6/1/04       Tue 6/15/04       D2         41       external       34 days       Wed 9/29/04       Mon 11/15/04 38       D2         42       PUBLIC RELATIONS       190 days       Mon 1/3/05       Sun 9/25/05       D3	38	MAKING THE PROJECT	23 days	Tue 6/1/04	Thu 7/1/04		D1
41     external     34 days     Wed 9/29/04     Mon 11/15/04     38     D2       42     PUBLIC RELATIONS     190 days     Mon 1/3/05     Sun 9/25/05     D3	39	WEB SITE	120 days	Tue 6/1/04	Mon 11/15/04		D2
42         PUBLIC RELATIONS         190 days         Mon 1/3/05         Sun 9/25/05         D3	40	internal	11 days	Tue 6/1/04	Tue 6/15/04		D2
	41	external	34 days	Wed 9/29/04	Mon 11/15/04	38	D2
43         FUND RAISING         67 days         Mon 5/2/05         Tue 8/2/05         38,41         D4	42	PUBLIC RELATIONS	190 days	Mon 1/3/05	Sun 9/25/05		D3
	43	FUND RAISING	67 days	Mon 5/2/05	Tue 8/2/05	38,41	D4

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#### **MiniDrive Cost**



#### 2005 FUTURE ENERGY CHALLENGE

Inverter and Motor Costing Spreadsheet

UNIVERSITY: University of Belgrade

NAME OF MAIN CONTACT: Igor Stamenkovic

PROJECT NAME: Min Drive

DATE: 5-Aug-05

ΟΤΥ	DESIG	UNIT	MEASURE	(Vpk)	(Vrms)	CUR (Avg)	CUR (Arms)	UNIT	EXTENDED
					(	1	(,,	the second se	6.35
						8			2.50
		121 223			3.5712111	4			2.28
				1000		1			4.30
8				100		1			4.14
				500		9			12.45
	1 VDR			275		4		0.62	0.62
8	1 C30	10	uF	25	201 25-21 (1928)	PERSONAL PROPERTY OF			0.10
8	3 C32, C35, C38	100	uF	63					0.47
	3 C20, C22, C24		uF	63				0.11	0.34
	3 C28, C71, CD6	100	uF	25				0.11	0.33
	1 C70			450				15.80	15.80
	1 C72	1	uF	630				2.45	2.45
	2 C73, C74	0.000001	uF	1000				0.63	1.26
	1 C29	0.01	uF	630				0.65	0.65
	1 R27	5	W					1.20	1.20
QTY	DESIG			note	Mass (kg)		Mass (kg)	UNIT COST	EXTENDED COST
1		The second	kg	of Ferrite		kg copper	100		
			kg of Powo	dered Iron		kg copper	222		
8			kg o	f Cool Mu		kg copper	100		
			kg d	of Si-steel		kg copper			
			k	g of SMC		kg copper	1000		
				kg of Al					
	QTY	3 D7, D8, D9 1 D26 1 D24 2 D4, D5 2 D21, D22 2 M1, M2 1 VDR 1 C30 3 C32, C35, C38 3 C20, C22, C24 3 C28, C71, CD6 1 C70 1 C72 2 C73, C74 1 C29 1 R27	3 D7, D8, D9 1 D26 1 D24 2 D4, D5 2 D21, D22 2 M1, M2 1 C30 3 C32, C35, C38 100 3 C32, C35, C38 100 3 C20, C22, C24 22 3 C28, C71, CD6 1 00 1 C70 5 60 1 C72 1 2 C73, C74 0.000001 1 R27 5	3 D7, D8, D9 1 D26 1 D24 2 D4, D5 2 D21, D22 2 M1, M2 1 VDR 1 C30 3 C32, C35, C38 100 UF 3 C32, C35, C38 100 UF 3 C20, C22, C24 2 UF 3 C28, C71, CD6 100 UF 1 C72 1 UF 2 C73, C74 0.000001 UF 1 C29 0.01 UF 1 R27 5 W kg of Power kg of kg of kg kg of kg of kg kg of kg kg of kg kg of kg kg of kg kg of kg of kg of kg of kg kg of kg kg of kg kg of kg kg kg of kg kg of kg kg kg of kg kg kg of kg kg kg of kg kg of kg kg kg of kg kg kg kg kg kg kg kg of kg kg kg kg kg of kg kg kg of kg kg of kg kg kg kg of kg kg kg kg kg of kg kg of kg kg kg of kg kg of kg kg kg of kg kg kg kg kg kg kg kg kg kg	QTY         DESIG         UNIT         MEASURE         (Vpk)           3         D7, D8, D9         600         600           1         D26         600           2         D4, D5         1000           2         D4, D5         1000           2         D21, D22         100           2         M1, M2         500           1         VDR         275           1         C30         10         uF           2         G32, C35, C38         100         uF           3         C20, C22, C24         22         uF           3         C28, C71, CD6         100         uF         25           3         C28, C71, CD6         100         uF         630           2         C73, C74         0.000001         uF         630           1         C29         0.01         uF         630           2         C73, C74         0.000001         uF         630           1         R27         5         W         trape	QTY         DESIG         UNIT         MEASURE         (Vpk)         (Vrms)           3         D7, D8, D9         600         600         600           1         D26         600         600         600           2         D4, D5         1000         201, 022         100         600           2         M1, M2         -         275         600         600         600           1         VDR         010         UF         255         63         630	QTY         DESIG         UNIT         MEASURE         (Vpk)         (Vrms)         (Avg)           3         D7, D8, D9         600         600         8           1         D26         600         4           2         D4, D5         1000         1           2         D4, D5         1000         1           2         D21, D22         500         9           1         VDR         275         4           1         C30         10         UF         25           3         C32, C35, C38         100         UF         633           3         C20, C22, C24         22         UF         633           3         C28, C71, CD6         100         UF         25           3         C28, C71, CD6         100         UF         630           2         C73, C74         0.000001         UF         630           2         C73, C74         0.000001         UF         630           2         C73, C74         0.000001         UF         630           1         R27         5         W         Kg of Powderelion           1         R27         5<	QTY         DESIG         UNIT         MEASURE         (Vpk)         (Vrms)         (Ave)         (Arms)           3 D7, D8, D9         1         D26         600         1         1           1 D26         600         600         8         1         1           1 D24         600         1 <td>QTY         DESIG         UNIT         MEASURE         (Vpk)         (Vrms)         (Avg)         (Arms)         COST           3         D7, D8, D9         -         600         8         2.12           1         D26         600         8         2.50           1         D24         600         4         2.28           2         D4, D5         -         1000         1         2.12           2         D4, D5         -         1000         1         2.28           2         D4, D5         -         1000         1         2.15           2         D21, D22         -         1000         1         2.07           2         NTM         2         500         9         6.22           1         VDR         275         4         0.62           1         C30         10         UF         633         0.10         0.62           3         C32, C35, C38         100         UF         633         0.11         0.11           3         C28, C71, CD6         100         UF         450         0.11         15.80           1         C72         1</td>	QTY         DESIG         UNIT         MEASURE         (Vpk)         (Vrms)         (Avg)         (Arms)         COST           3         D7, D8, D9         -         600         8         2.12           1         D26         600         8         2.50           1         D24         600         4         2.28           2         D4, D5         -         1000         1         2.12           2         D4, D5         -         1000         1         2.28           2         D4, D5         -         1000         1         2.15           2         D21, D22         -         1000         1         2.07           2         NTM         2         500         9         6.22           1         VDR         275         4         0.62           1         C30         10         UF         633         0.10         0.62           3         C32, C35, C38         100         UF         633         0.11         0.11           3         C28, C71, CD6         100         UF         450         0.11         15.80           1         C72         1

# **Running the Project**

- When the planning phase is over, the "doing" phase begins
- There are two key elements to the control of a project
   *milestones* (clear, unambiguous targets of what, by when)
  - o established *means of communication*
- Description of the activities as a communication tool:

Activity Description		
Project:	Project name	Page 1 of 1
Activity:	5.5.20.5 Evaluate Writte	
Description:		als received from vendors in response to the RFP.
Inputs:	<ul> <li>Requirements defi</li> </ul>	nition (5.5.5)
	<ul> <li>Request for propo</li> </ul>	sal (5.5.15)
	<ul> <li>Written proposals</li> </ul>	from vendors
Effort:	Review vendor pro	oposals
	<ul> <li>Reject proposals t</li> </ul>	hat do not meet mandatory requirements
	<ul> <li>Weight proposals</li> </ul>	for degree of compliance to optional requirements
	<ul> <li>Prepare recomment</li> </ul>	ndations for short list
Resources:	Project manager (2	20%)
	<ul> <li>Hardware analyst</li> </ul>	(80%)
Outputs:	<ul> <li>Evaluation results</li> </ul>	consisting of:
	<ul> <li>Short list of qualifier</li> </ul>	ed vendors or
	<ul> <li>Rejection of all pro</li> </ul>	posals
	Letters to vendors	informing them of evaluation results

# **Running MiniDrive Project**



#### • Being formal.

When we wanted to find out how people were doing, we never asked casually and never relied on an oral response

#### • Being specific.

We made sure all team members understood that when they say an activity is complete, it is complete

#### • Form appropriate documentation.

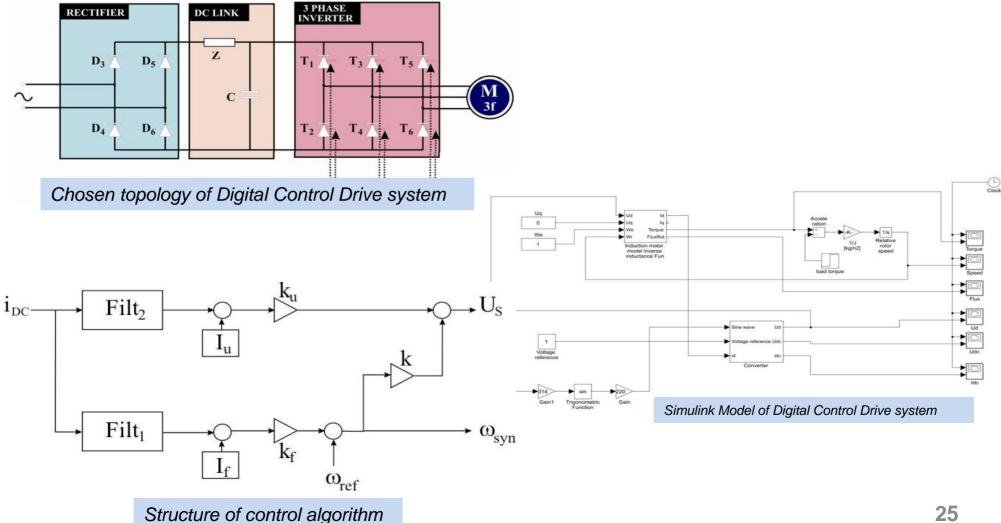
Documenting the activities is important because later, anybody can do the same activity just using the existing documentation

	Progress Report	
Project:	For Week Ending:	
Name:		
	Schedule Completio	
		_
	· · ·	
Progress Made		

Example of weekly progress report

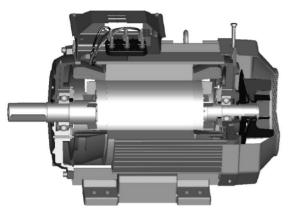


#### **Progress in simulating and testing the drive** •

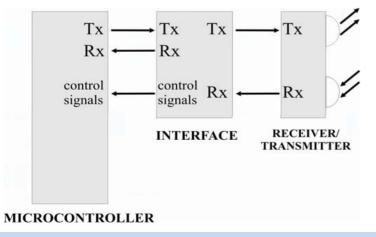




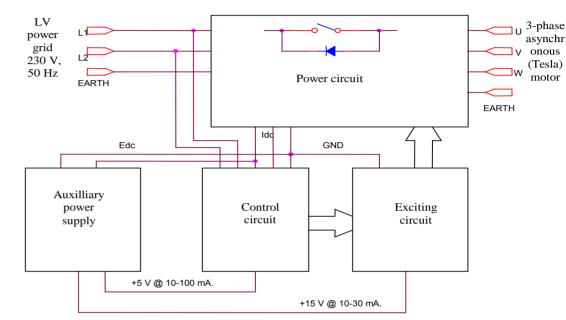
#### Progress with hardware



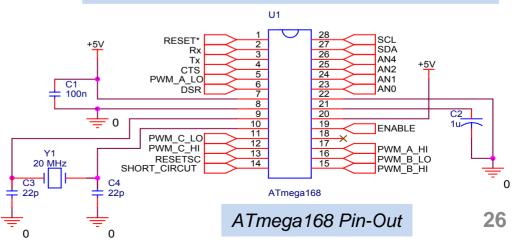
One of the options - ABB induction motor



IC circuits for realization of IR communication



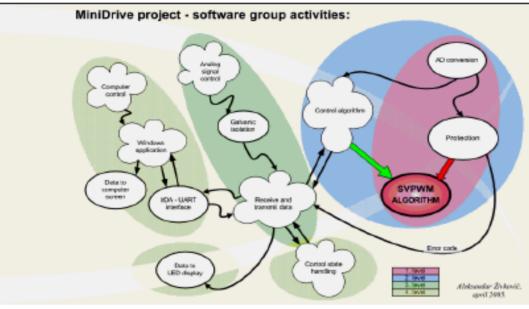
#### Proposed structure of miniature drive converter



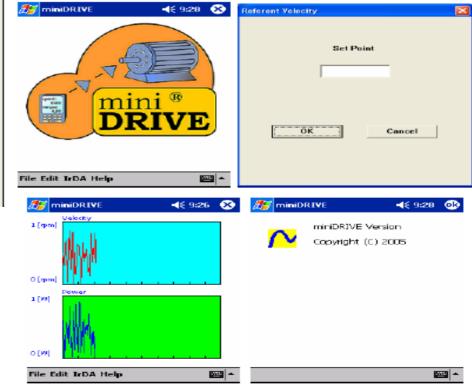


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#### Progress with software



The software group activities



Graphical User Interface for Pocket PC



**Progress of the marketing group** •







University of Belgrade Student Branch Mini Drive Team.

EVERY OTHER year, four IEEE societies (Power Electronics, Industry Applications, Power Engineering and Industrial Electronics) run a worldwide Future Energy Challenge competition. All graduate and post-graduate students from all over the world are encouraged to take part.

The Laboratory for Digital Control of Electrical Drives in the Faculty of Electrical Engineering at Belgrade University applied on June 2004. 20 students led by two post-graduates presented the first results at an IEEE conference in Seattle on 6-9 October 2004. Our team was the only non-American team to reach the final stage of the contest which will be held in Chicago, USA, on 15-19 August 2005.

This year, the goal of the contest is to make a singlephase adjustable speed motor

drive with characteristics that comply with strict standards. The most important criteria is the production price that should be under US\$40.

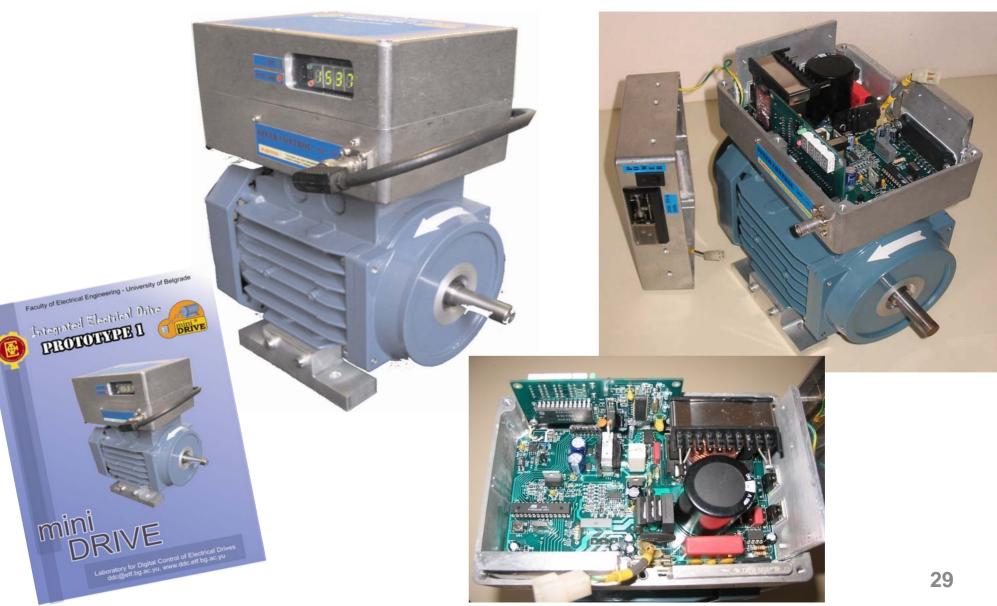
The competition allows students to get creative while at the same time improving their knowledge on the particular subject. This project is also useful for students in gaining experience in delivering conference papers and writing technical documentation. Not least, it is highly motivating to realize that something they developed will have some practical value.

If you would like to find out more about our work on this project, please get in touch at the contacts below. Miloš Rakic Nikola Milivojevic Belgrade-MiniDriveTeam ddc@etf.bg.ac.yu www.md.etf.bg.ac.yu

Istanbul Technical University, Turkey:

### MiniDrive Prototype





#### MiniDrive Success











#### **Conclusions**

- Project Management necessity of Engineering Project
- Start on time
- Delegate
- Expect failures, overcome problems
- Invest time instead of money
- Keep groups cross-functional and allow cross communication
- Allow panel discussions, bring all possible solutions on table
- Manage different mentality of team members
- Bad experience is still an experience, which may turn into success!

