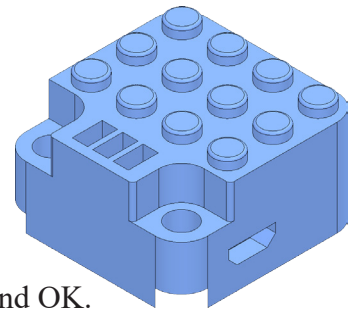


# Chapter 15

## E's Small Car Battery



### A. Extrude1 Sketch1 Body.

Step 1. Click **New** on the Standard toolbar, click **Part Metric** and OK.

Step 2. Click **Top Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 1**.

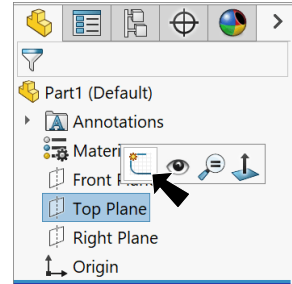


Fig. 1

Step 3. Click **Center Rectangle** in the **Rectangle** flyout on the Sketch toolbar.

Step 4. Sketch center rectangle at the **Origin** , **Fig. 2**.

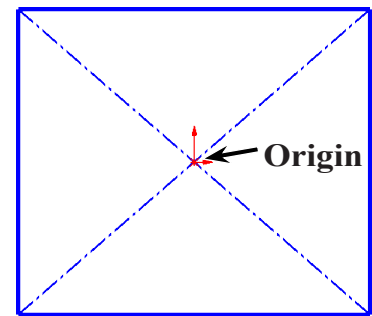


Fig. 2

Step 5. **Unselect Rectangle tool**. To unselect, right click graphics area and click **Select** from menu.

Step 6. **Ctrl click two adjacent sides of the rectangle** and click **Make Equal** on the context toolbar, **Fig. 3**.

Step 7. Click **Smart Dimension**



(S).

Step 8. Add **32** dimension, **Fig. 4**.

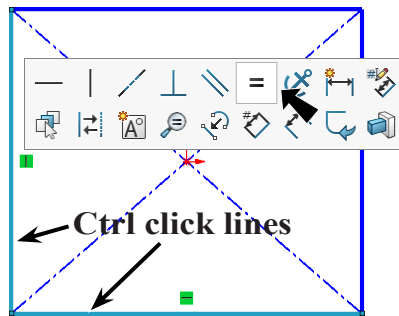


Fig. 3

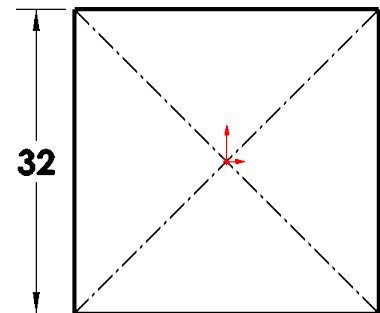


Fig. 4

Step 9. Click **Features** on the Command Manager toolbar.

Step 10. Click **Extruded Boss/Base** on the Features toolbar.

Step 11. In the Boss-Extrude Property Manager:

under **Direction 1**, **Fig. 5**

End Condition **Blind**

**Depth** **17**

click **OK** .

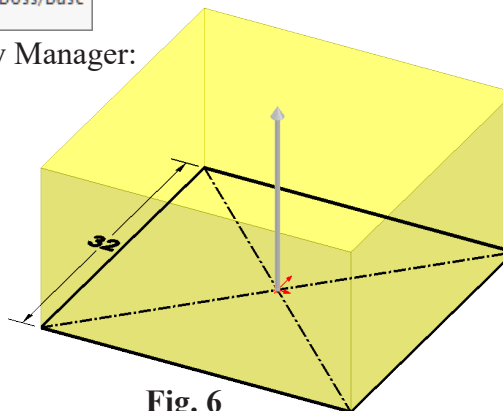


Fig. 6

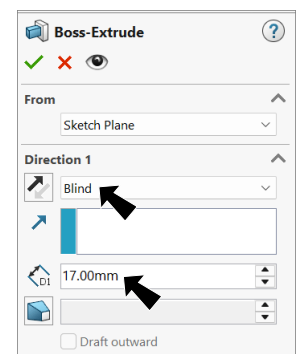


Fig. 5


### B. Save as "BATTERY".



Step 1. Click **File Menu** > **Save As**.

Step 2. Key-in **BATTERY** for the filename and press **ENTER**.


### C. Extruded Cut 1 Sketch 2 Corner.


Step 1. Click **Isometric**  on the Standard Views toolbar. (Ctrl-7)

Step 2. Click the **top face** and click **Sketch**  on the context toolbar, Fig. 7.

Step 3. Click **Corner Rectangle**  in the **Rectangle flyout**  on the Sketch toolbar.

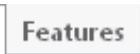
Step 4. Sketch **corner rectangle front right corner vertex**, Fig. 8.

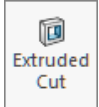
Step 5. **Unselect Rectangle tool.** To unselect, right click graphics area and click **Select**  from menu.

Step 6. **Click a vertex of rectangle** and click **Make Equal**  on the context toolbar, Fig. 9.

Step 7. Click **Smart Dimension**  (S) on the Sketch toolbar.

Step 8. Add **8.6 dimension**, Fig. 10.

Step 9. Click **Features**  on the Command Manager toolbar.

Step 10. Click **Extruded Cut**  on the Features toolbar.

Step 11. In the Cut-Extrude Property Manager set:  
under Direction 1, Fig. 11

**Depth**  **6**  
click **OK** .

Step 12. Save  (Ctrl-S).

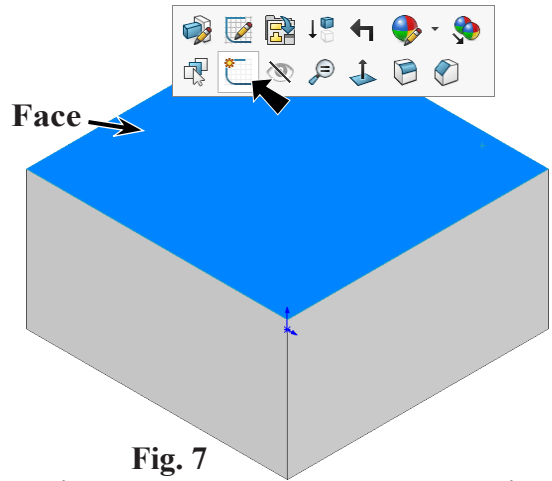


Fig. 7

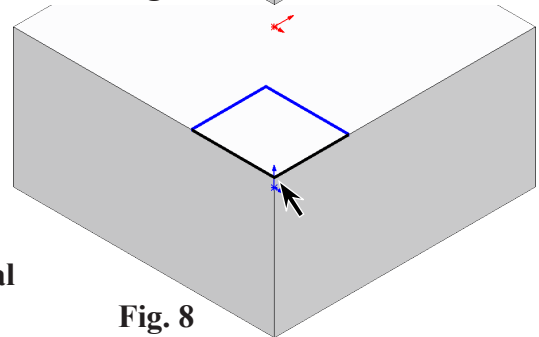


Fig. 8

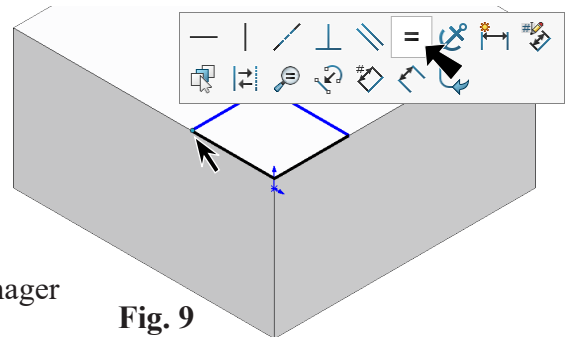


Fig. 9

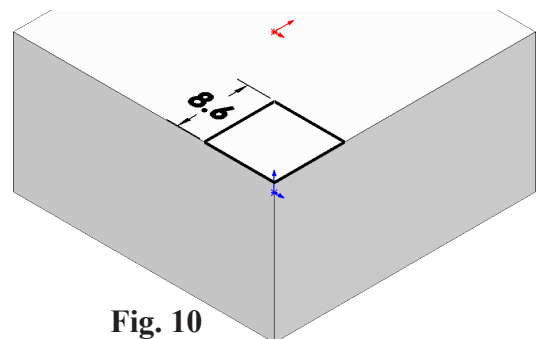


Fig. 10

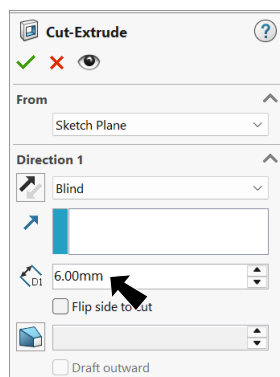


Fig. 11

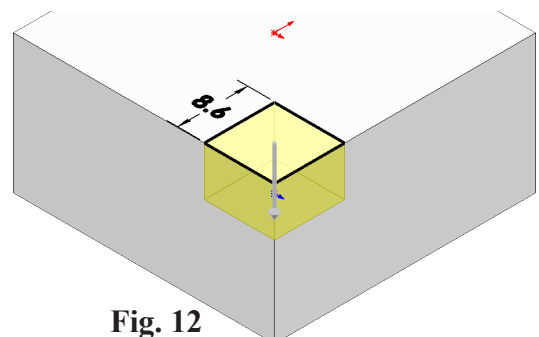


Fig. 12

## D. Fillets 1-3.

Step 1. Click **Fillet**  on the Features toolbar.

Step 2. In the Fillet Property Manager set:  
select **FilletXpert**, Fig. 13

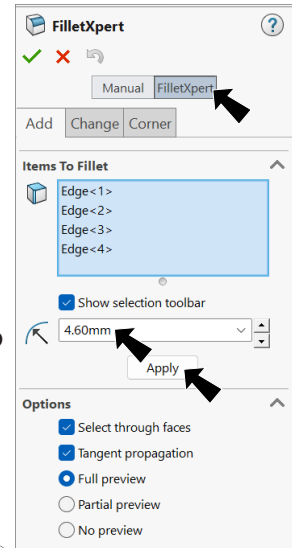


Fig. 13

① **Radius**  **4.6**  
click vertical edge of Battery (1), Fig. 14

click **Connected to end face**  **3 edges** on the Fillet pop-up  
click **Apply**

Radius 4.6

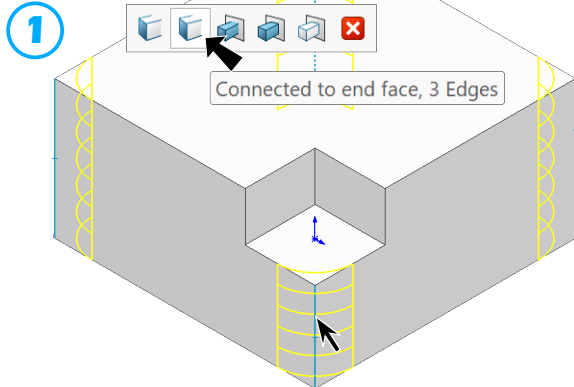


Fig. 14

② **Radius**  **4**  
click vertical back edge of cut (1), Fig. 15

click **Apply**

Radius 4

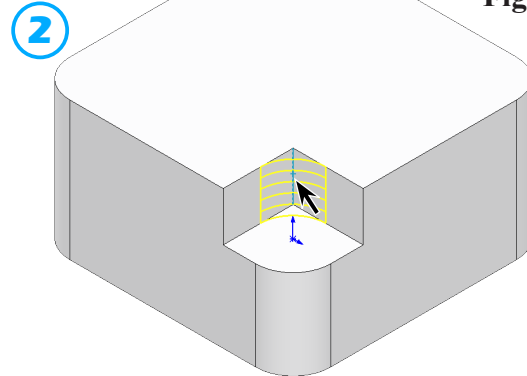


Fig. 15

③ **Radius**  **.7**  
click vertical side edges of cut (2), Fig. 16  
click **OK** .

Radius .7

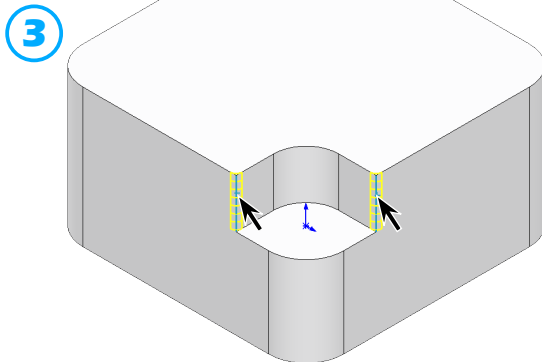


Fig. 16

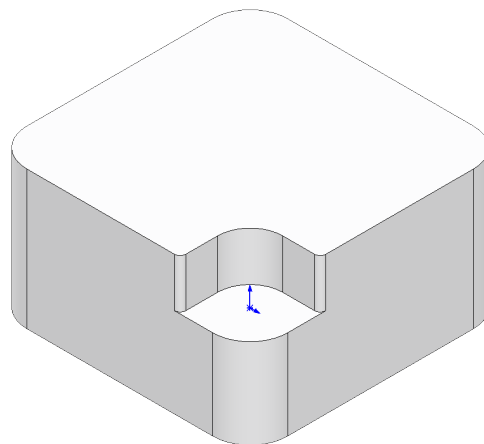


Fig. 17

Step 3. Save  (Ctrl-S).

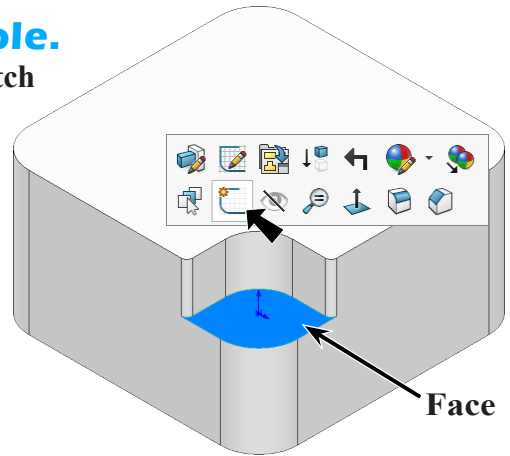
## E. Extruded Cut2 Sketch3 Terminal Hole.

Step 1. Click the **bottom face** Cut-Extrude1 and click **Sketch**

 on the context toolbar, **Fig. 18**.

Step 2. Click **Circle**  (S) on the Sketch toolbar.

Step 3. Sketch **circle concentric with Fillet1**, **Fig. 19**. To wake up centerpoint, hover cursor over circular edge.



**Fig. 18**

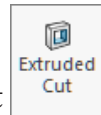
Step 4. Click **Smart Dimension**  (S) on the Sketch toolbar.

Step 5. Dimension **diameter 5**, **Fig. 20**.

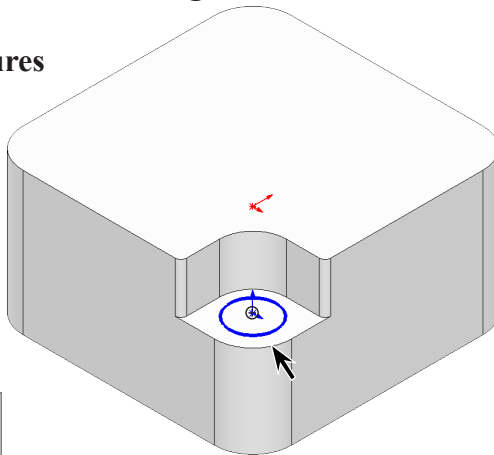
Step 6. Click **Features**

  
on the  
Command  
Manager  
toolbar.

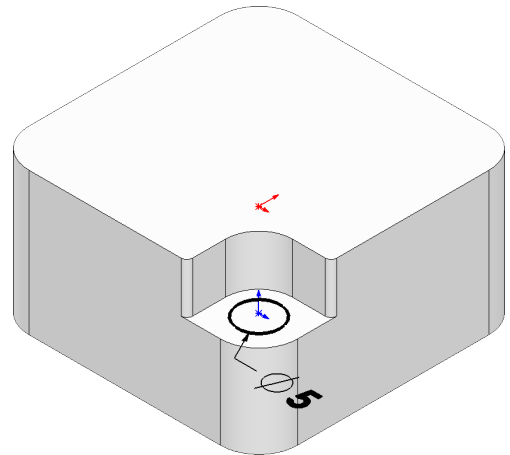
Step 7. Click **Extruded**

**Cut** 

on the Features toolbar.



**Fig. 19**



**Fig. 20**

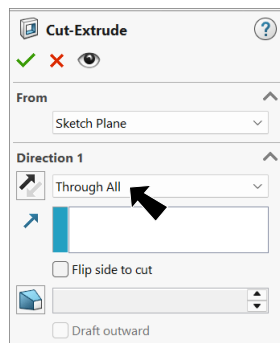
Step 8. In the Cut-Extrude Property Manager set:

under **Direction 1**, **Fig. 21**

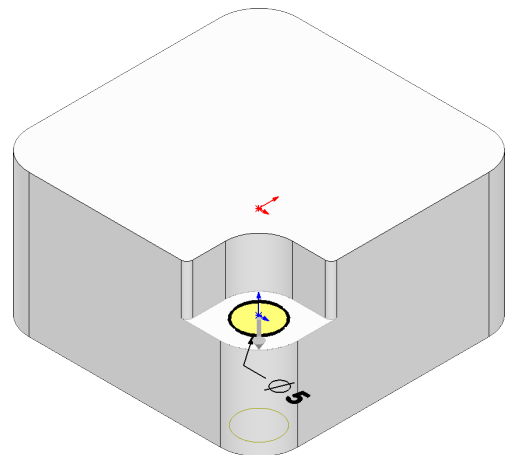
End Condition **Through All**

click OK .

Step 9. Save  (Ctrl-S).



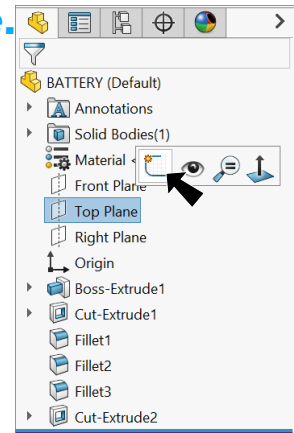
**Fig. 21**



**Fig. 22**

## F. Extruded Cut3 Sketch4 Terminal Counterbore.

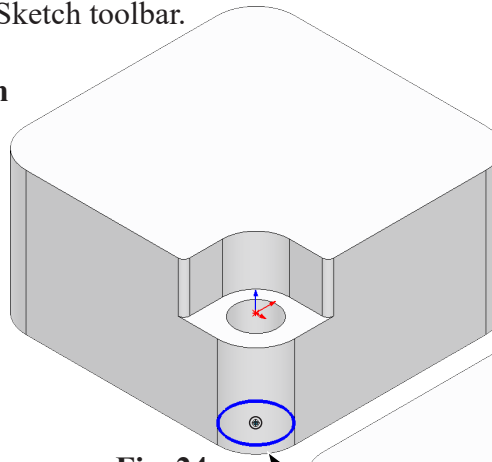
Step 1. Click **Top Plane**  in the Feature Manager and click **Sketch**  on the context toolbar, **Fig. 23**.




**Fig. 23**

Step 2. Click **Circle**  (S) on the Sketch toolbar.

Step 3. Sketch **circle concentric with Fillet1**, **Fig. 24**. To wake up centerpoint, hover cursor over circular edge.

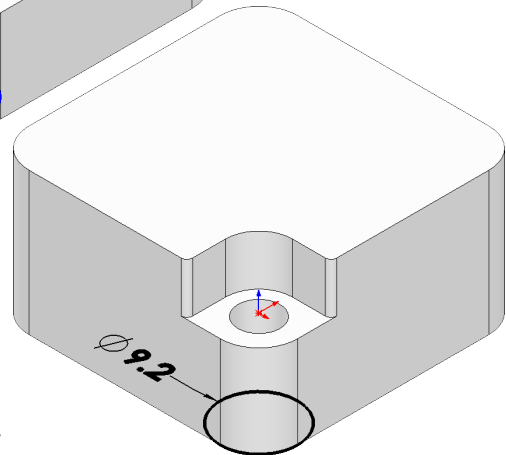


**Fig. 24**

Step 4. Click **Smart Dimension**  (S) on the Sketch toolbar.

Step 5. Dimension **diameter 9.2**, **Fig. 25**.

Step 6. Click **Features**  on the Command Manager toolbar.

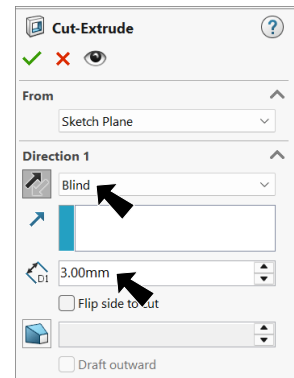


**Fig. 25**

Step 7. Click **Extruded Cut**  on the Features toolbar.

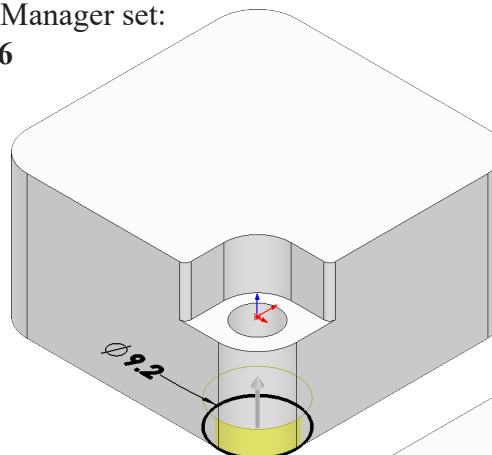
Step 8. In the Cut-Extrude Property Manager set:  
under Direction 1, **Fig. 26**  
End Condition **Blind**

**Depth**  **3**  
click OK .

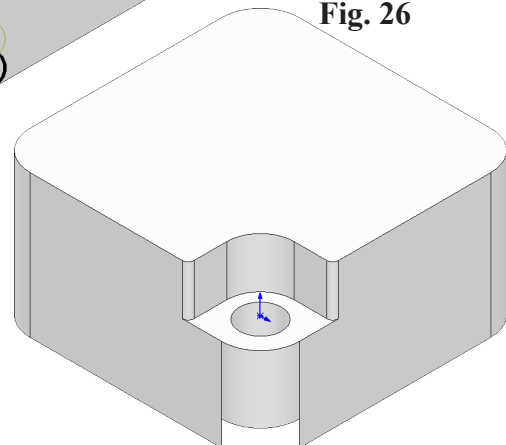


**Fig. 26**

Step 9. Save  (Ctrl-S).



**Fig. 27**



**Fig. 28**

## G. Mirror Terminal Features.

Step 1. Ctrl click Right Plane , Cut-Extrude1, Cut-Extrude2, Cut-Extrude3 and both terminal cut Fillets feature to select plane and features, Fig. 29.

Step 2. Click Mirror  on the Features toolbar.

Step 3. In the Mirror Property Manager click OK , Fig. 30.

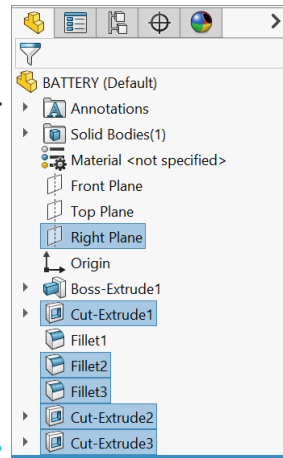


Fig. 29

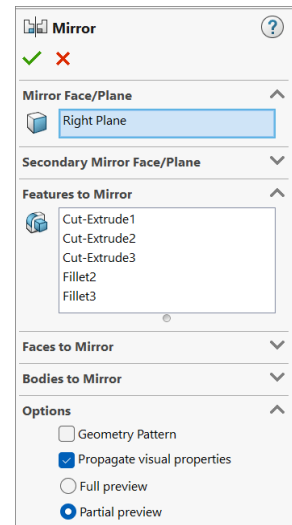


Fig. 30

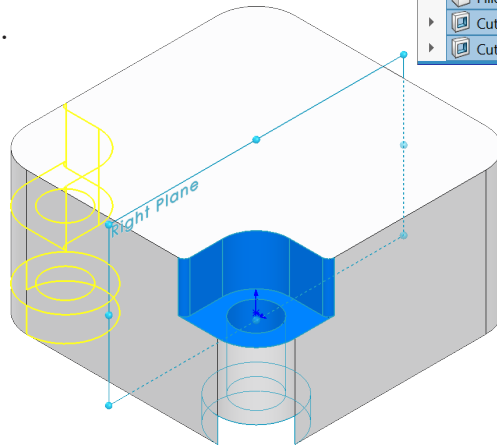





Fig. 31

## H. Extruded Cut4 Sketch5 Power Cable Jack.

Step 1. Click the top face and click Sketch  on the context toolbar, Fig. 32.

Step 2. Click Corner Rectangle  in the Rectangle flyout  on the Sketch toolbar.

Step 3. Sketch corner rectangle front right corner vertex, Fig. 33.

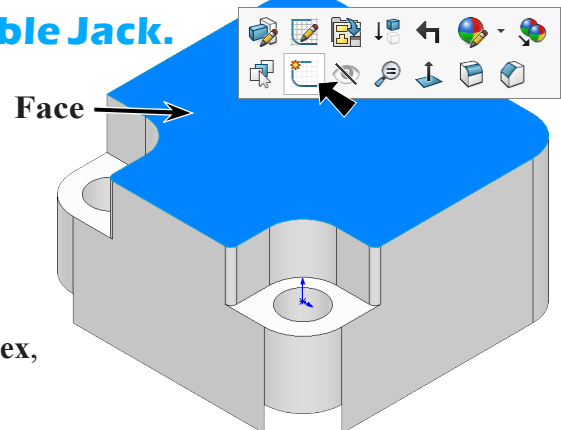


Fig. 32

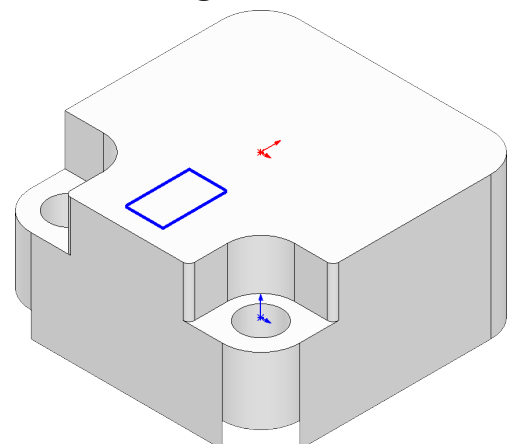
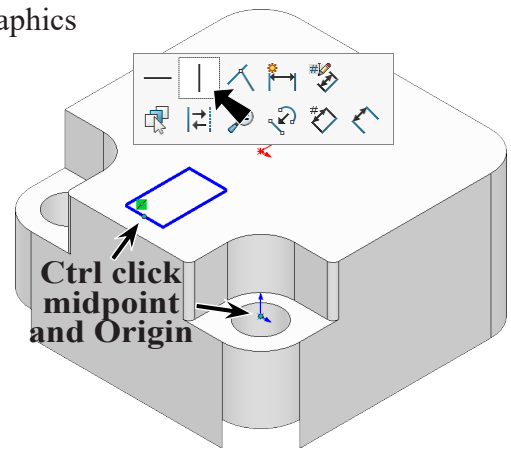


Fig. 33

Step 4. **Unselect Rectangle tool.** To unselect, right click graphics area and click **Select** from menu.

Step 5. **Ctrl click midpoint** of a horizontal line and

**Origin** (blue) to select both. Release Ctrl key and click **Make Vertical** on the context toolbar, **Fig. 34.**



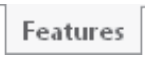
**Fig. 34**

Step 6. Click **Smart Dimension** (S) on the Sketch toolbar.

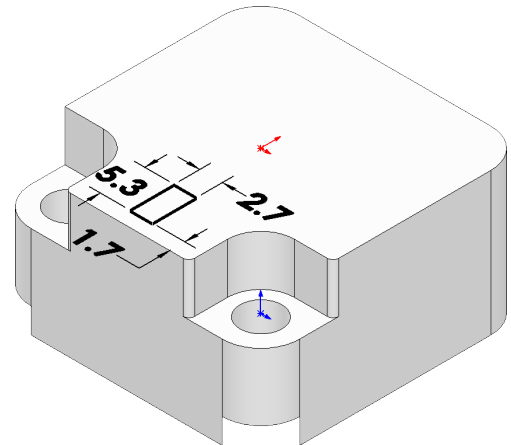
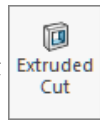


Step 7. Add dimensions, **Fig. 35.**

Step 8. Click **Features** on the Command Manager toolbar.



Step 9. Click **Extruded Cut** on the Features toolbar.



**Fig. 35**

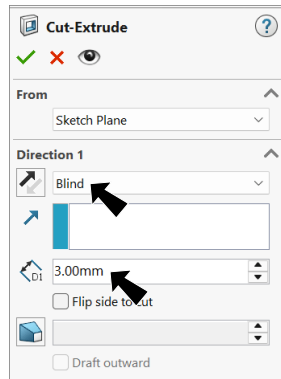
Step 10. In the Cut-Extrude Property Manager set:

under Direction 1, **Fig. 36**

End Condition **Blind**

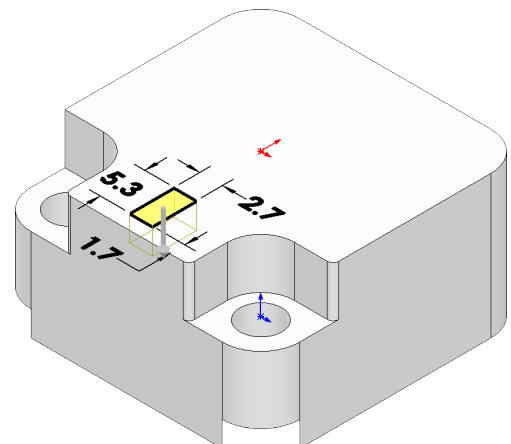
**Depth** 3

click **OK**.



**Fig. 36**

Step 11. Save (Ctrl-S).



**Fig. 37**

# I. Linear Pattern.

Step 1. Click **Linear Pattern**  on the Features toolbar.

Step 2. In the Linear Pattern Property Manager set:

under Direction 1, **Fig. 38**

click a **front edge**, **Fig. 39**

**Spacing**  **D1 3.6**

**Number of Instances**  **# 2**

under Direction 2

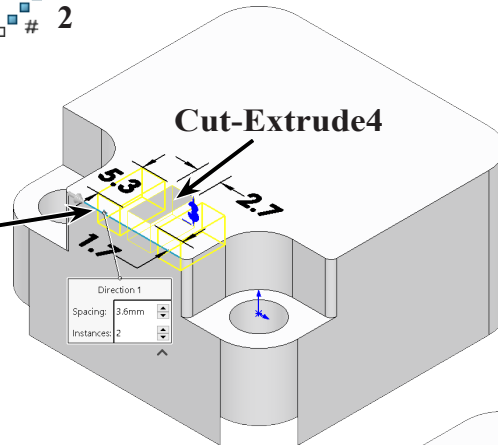
check **Symmetric**

under Features and Faces

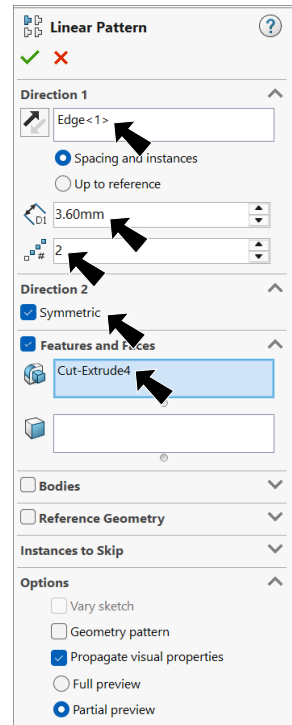
click **Cut-Extrude4**

click OK .

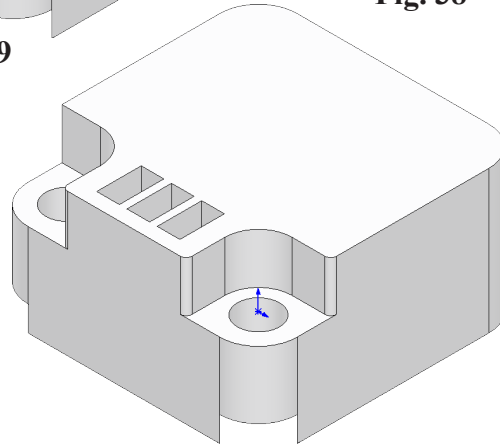
**Edge** 



**Fig. 39**




**Fig. 38**



**Fig. 40**

## J. Extruded Cut5 Sketch6 Charging Jack.


Step 1. Click the **right side face** and click **Sketch**  on the context toolbar, **Fig. 41**.

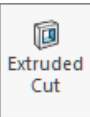
Step 2. Click **Corner Rectangle**  in the **Rectangle flyout**  on the Sketch toolbar.



Step 3. Sketch **corner rectangle**, **Fig. 42**.

Step 4. Click **Smart Dimension**  (S) on the Sketch toolbar.

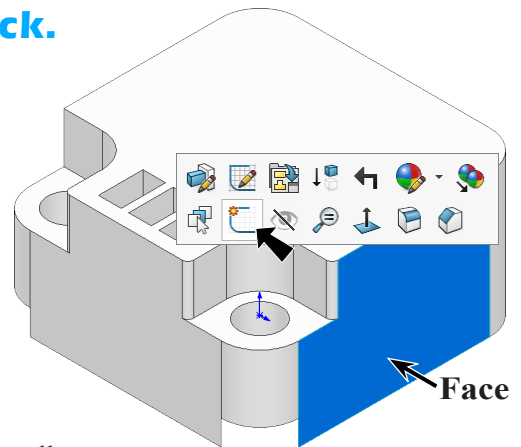
Step 5. Add dimensions, **Fig. 43**.

Step 6. Click **Features**  on the Command Manager toolbar.

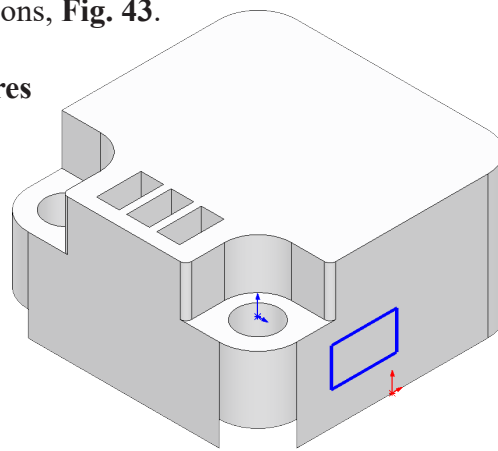
Step 7. Click **Extruded Cut**  on the Features toolbar.

Step 8. In the Cut-Extrude Property Manager set:  
 under Direction 1, **Fig. 44**  
 End Condition **Blind**  
**Depth**  **3**  
 click OK .

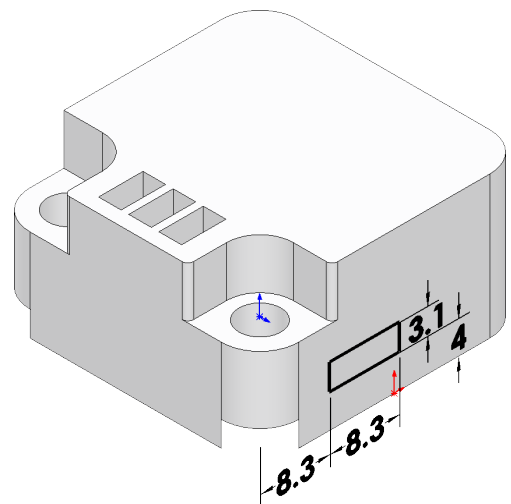
Step 9. Save  (Ctrl-S).



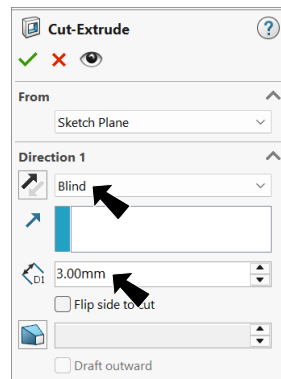
**Fig. 41**



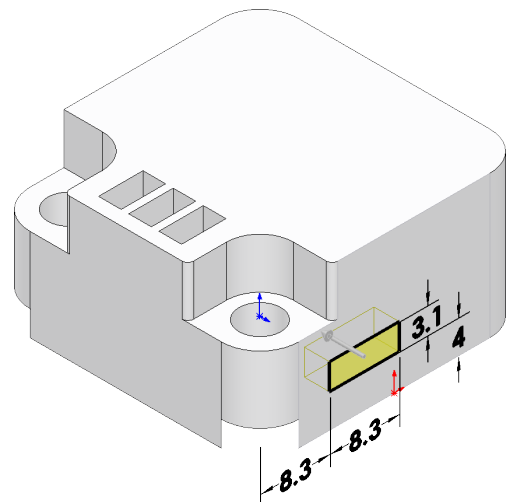
**Fig. 42**



**Fig. 43**

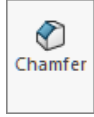


**Fig. 44**



**Fig. 45**

## K. Chamfers.

Step 1. Click **Chamfer**  on the Features toolbar.

Step 2. In the Chamfer Property Manager set:  
under Chamfer Type, **Fig. 46**

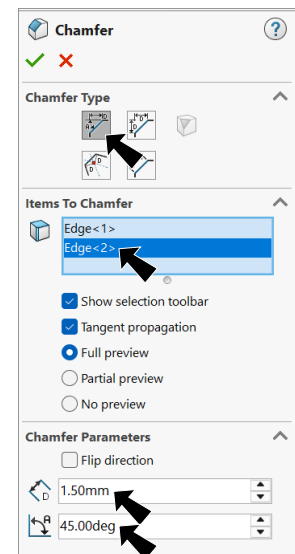
select **Angle Distance** 

click **both bottom corner edges of Cut-Extrude5**, **Fig. 47**  
under Chamfer Parameters

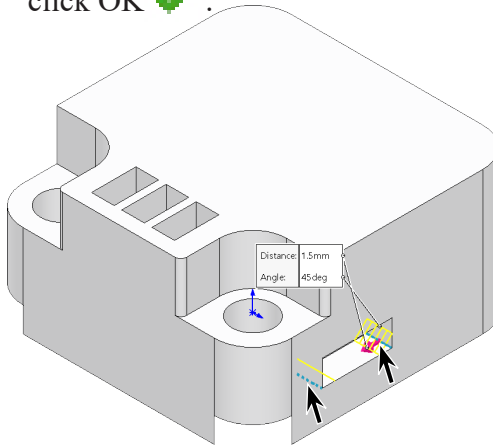
Distance  1.5

Angle  45°

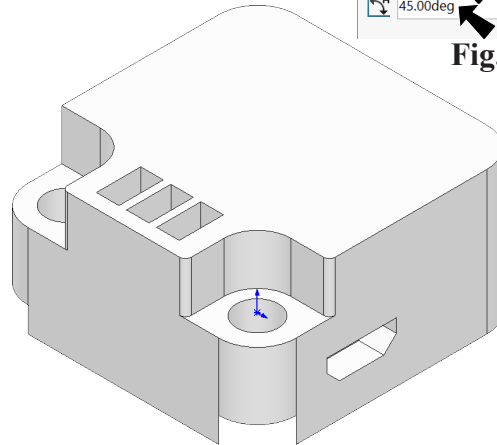
click OK .



**Fig. 46**




**Fig. 47**



**Fig. 48**


## L. Extruded Cut6 Sketch7 Charging Jack.

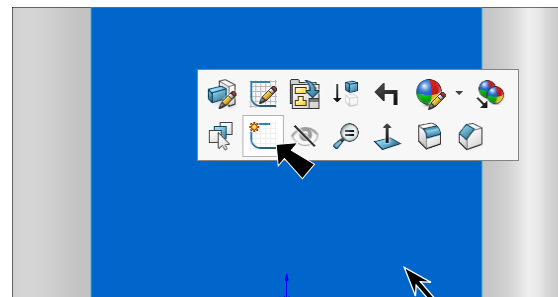
Step 1. Click **Back**  on the Standard Views toolbar. (Ctrl-2)

Step 2. Click the **back face** and click **Sketch**  on the context toolbar, **Fig. 49**.

Step 3. Click **Corner Rectangle**  in the **Rectangle flyout**  on the Sketch toolbar.

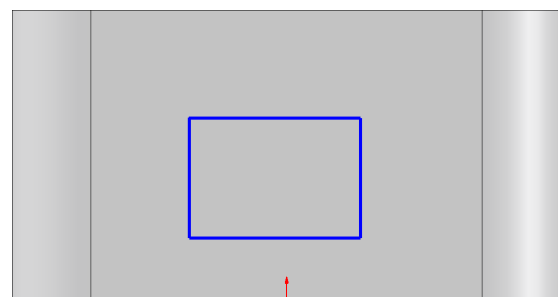
Step 4. Sketch **corner rectangle**, **Fig. 50**.

Step 5. **Unselect Rectangle tool**. To unselect, right click graphics area and click **Select**  from menu.






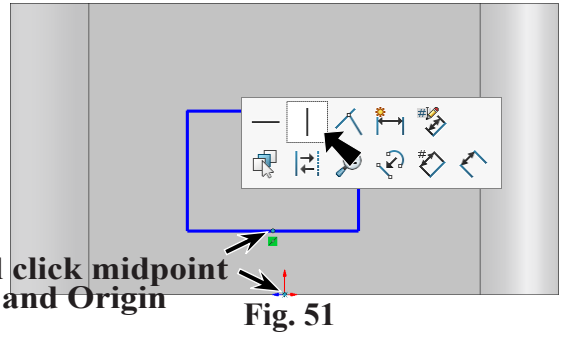
**Fig. 49**

**Face**



**Fig. 50**

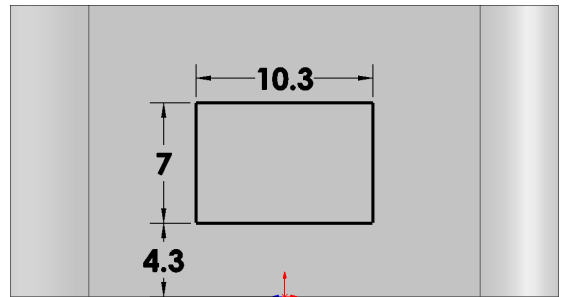
Step 6. **Ctrl click midpoint**  of a horizontal line and **Origin**  to select both. Release Ctrl key and click **Make Vertical**  on the context toolbar, **Fig. 51**.





Step 7. Click **Smart Dimension**  (S) on the Sketch toolbar.

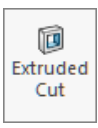
**Ctrl click midpoint and Origin** **Fig. 51**




Step 8. Add dimensions, **Fig. 52**.

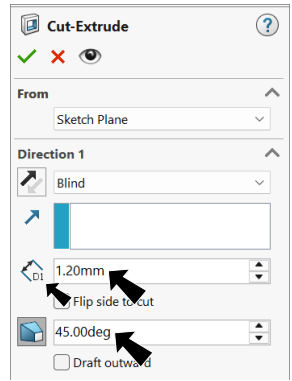


Step 9. Rotate view to cut, **Fig. 54**. To rotate view, **Right Arrow key**  and **Down Arrow key** .

Step 10. Click **Features**  on the Command Manager toolbar. **Fig. 52**

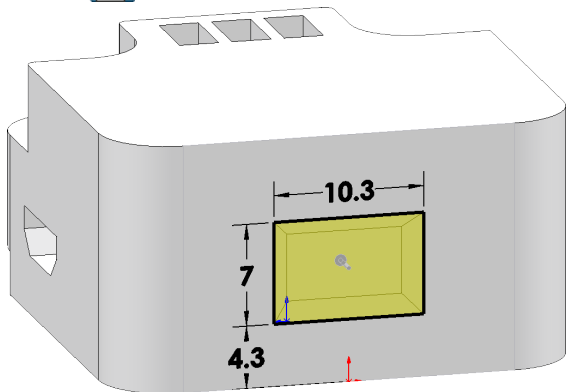
Step 11. Click **Extruded Cut**  on the Features toolbar.

Step 12. In the Cut-Extrude Property Manager set:  
 under Direction 1, **Fig. 53**  
 End Condition **Blind**  
**Depth**  **1.2**  
 click **Draft**  **45°**  
 click **OK** .

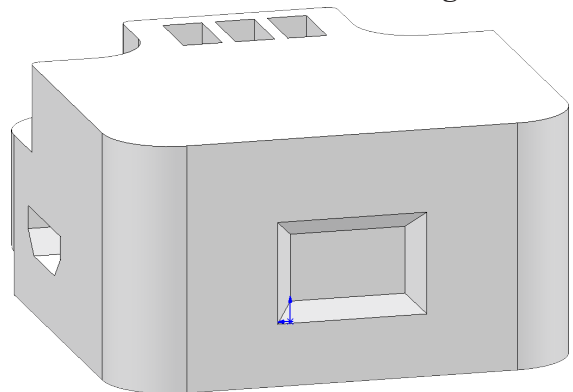


Step 13. Save  (Ctrl-S).

**Fig. 53**




**Fig. 54**



**Fig. 55**


## M. Extrude2 Sketch8 Lego 3 by 4 Studs.


Step 1. Click the **top face** and click **Sketch**  on the context toolbar, **Fig. 56**.


Step 2. Click **Normal To**  on the Standard Views toolbar. (**Ctrl-8**)


Step 3. Click **Circle**  (**S**) on the Sketch toolbar.

Step 4. Sketch **two circles in top left**, **Fig. 57**.

Step 5. **Unselect Circle tool**. To unselect, right click graphics area and click **Select**  from menu.

Step 6. **Drag selection to left to select both circles** and click **Make Equal**  on the context toolbar, **Fig. 58**.

Step 7. **Ctrl click both circle centerpoints** to select both. Release **Ctrl** key and click **Make Horizontal**  on the context toolbar, **Fig. 59**.

Step 8. Click **Right Plane**  in the Feature Manager to select plane, **Fig. 60**.

Step 9. **Ctrl drag** a selection to **select both circles**, **Fig. 61**.

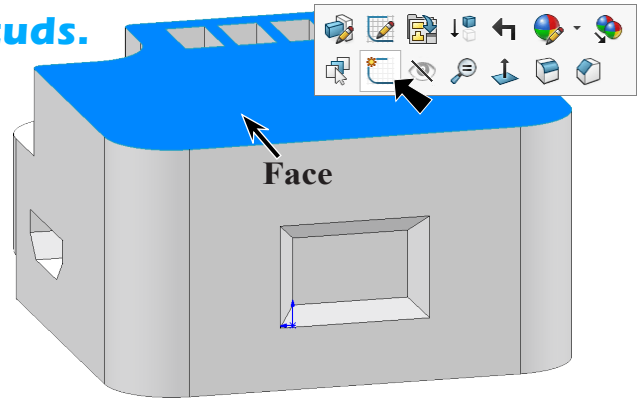


Fig. 56

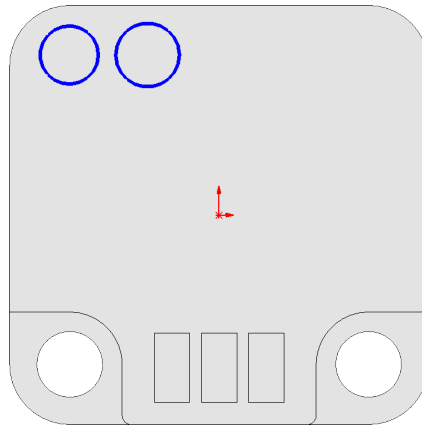


Fig. 57

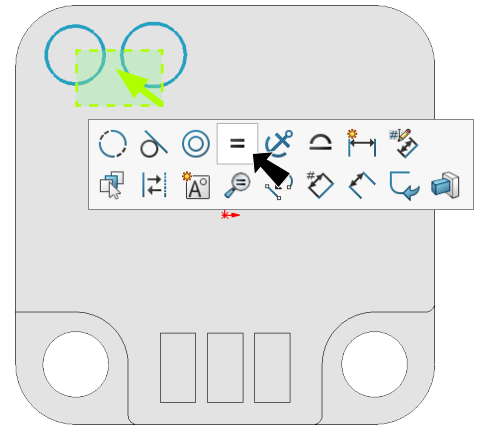


Fig. 58

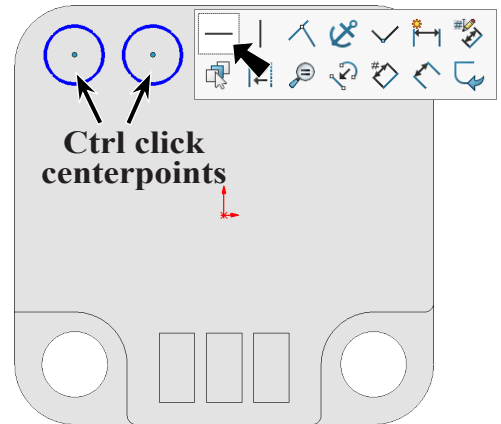


Fig. 59

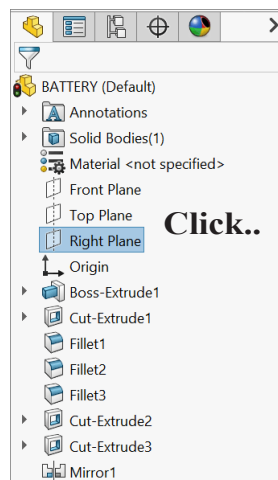


Fig. 60

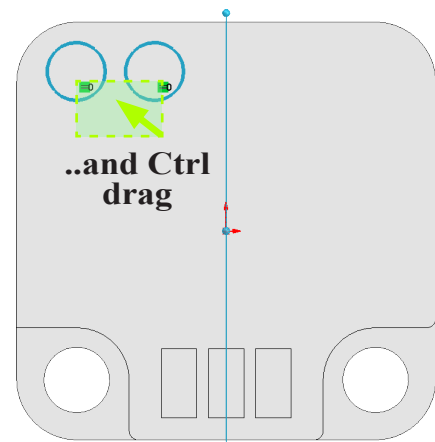


Fig. 61

Step 10. Click **Mirror Entities**  on the Sketch toolbar.

Step 11. Click **Smart Dimension**  (S) on the Sketch toolbar.

Step 12. Add dimensions, **Fig. 62**.

Step 13. Click **Linear Sketch Pattern**  on the Sketch toolbar.

Step 14. In the Linear Pattern Property Manager set:  
 under Entities to Pattern, **Fig. 63**

click in  box  
 click the **circles**, **Fig. 64**

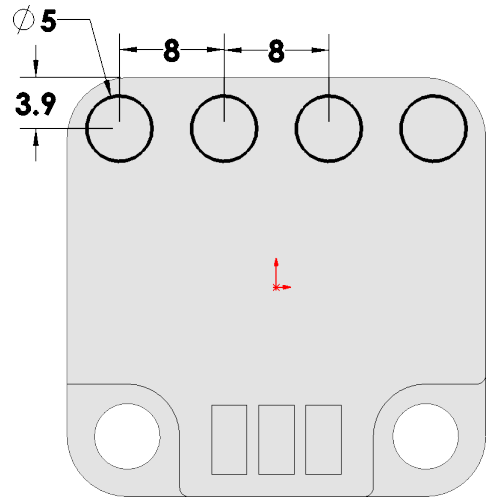
under Direction 1  
 Direction X-axis

Spacing  8  
 check **Dimension X spacing**

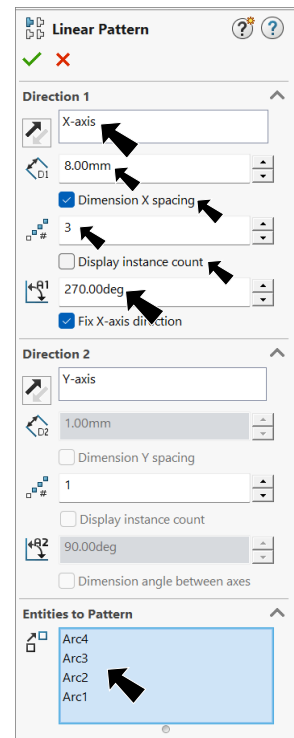
**Number of Instances**  3  
 uncheck **Display instance count**

**Angle**  270

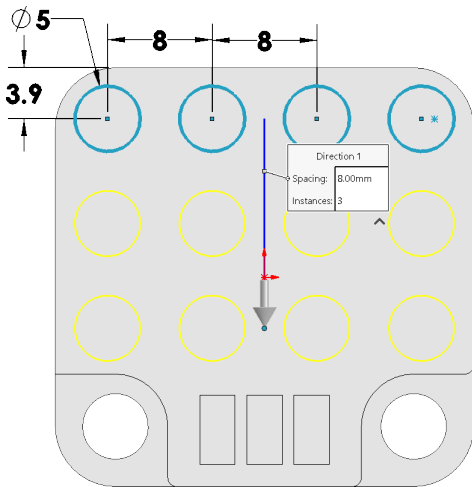
click OK .



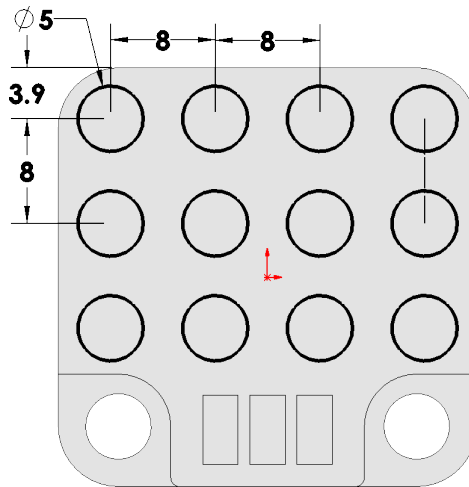
**Fig. 62**




**Fig. 63**



**Fig. 64**





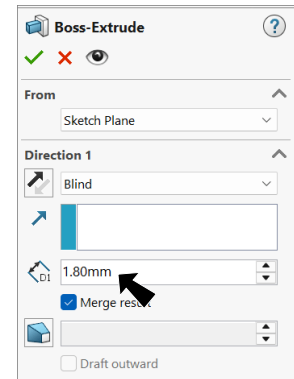
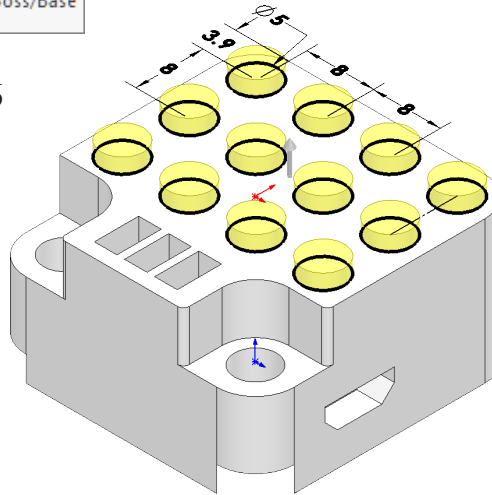
**Fig. 65**

Step 15. Click **Isometric**  on the Standard Views toolbar. (**Ctrl-7**)

Step 16. Click **Features**  on the Command Manager toolbar.

Step 17. Click **Extruded Boss/Base**  on the Features toolbar.

Step 18. In the Property Manager set:  
under Direction 1, **Fig. 66**  
End Condition **Blind**  
**Depth**  **1.8**  
click OK .






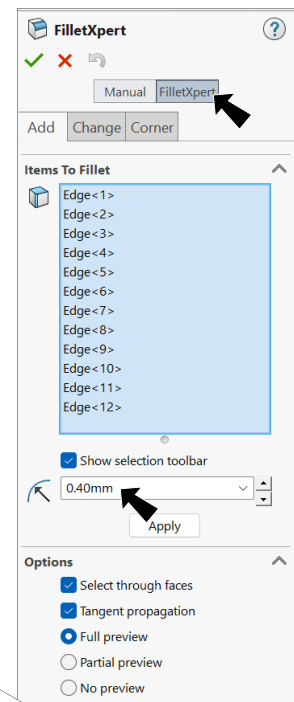
**Fig. 66**

## N. Fillet4.

Step 1. Click **Fillet**  on the Features toolbar.

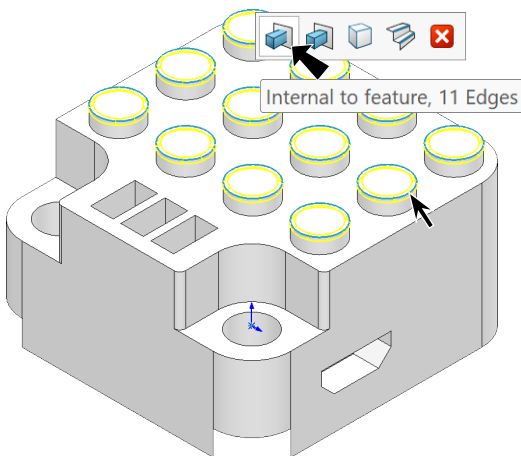
Step 2. In the Fillet Property Manager set:  
select **FilletXpert**, **Fig. 68**

**4** **Radius**  **.4**  
click a **top edge of stud**, **Fig. 69**  
click **Internal to feature**  **11 edges** on the Fillet pop-up  
click OK .

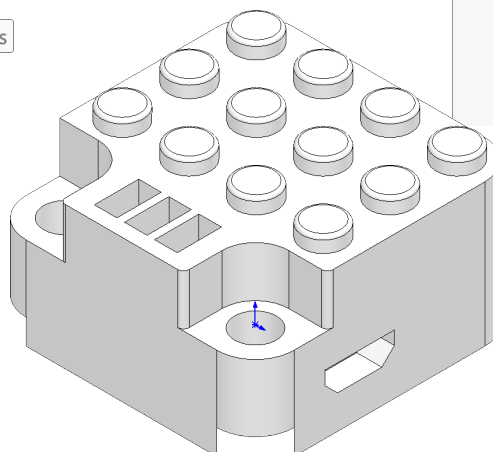


**Fig. 68**

Step 3. Save  (**Ctrl-S**).





**Fig. 69**



**Fig. 70**

## O. Appearance: Blue Plastic.

Step 1. Click the Battery to select part, click **Appearances Callout**

 on the context toolbar and click **Battery** , Fig. 71.

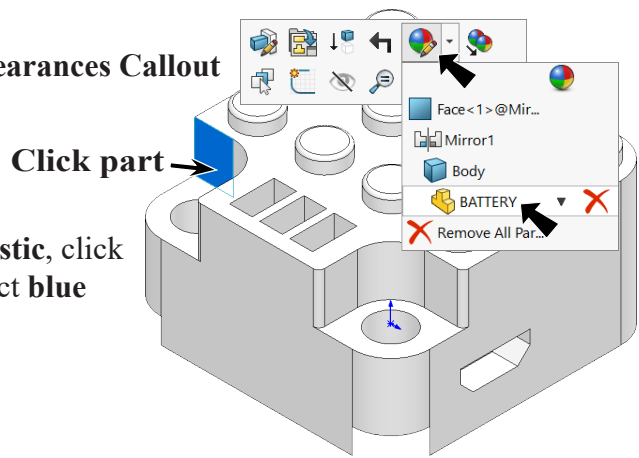


Fig. 71

Step 2. In the Appearances Task pane, expand **Plastic**, click **Medium Gloss** and in the lower pane select **blue medium gloss plastic**, Fig. 72.

Step 3. In the Appearances Property Manager, under Color, Fig. 73

set RGB values

R 132

G 175

B 255

click OK .

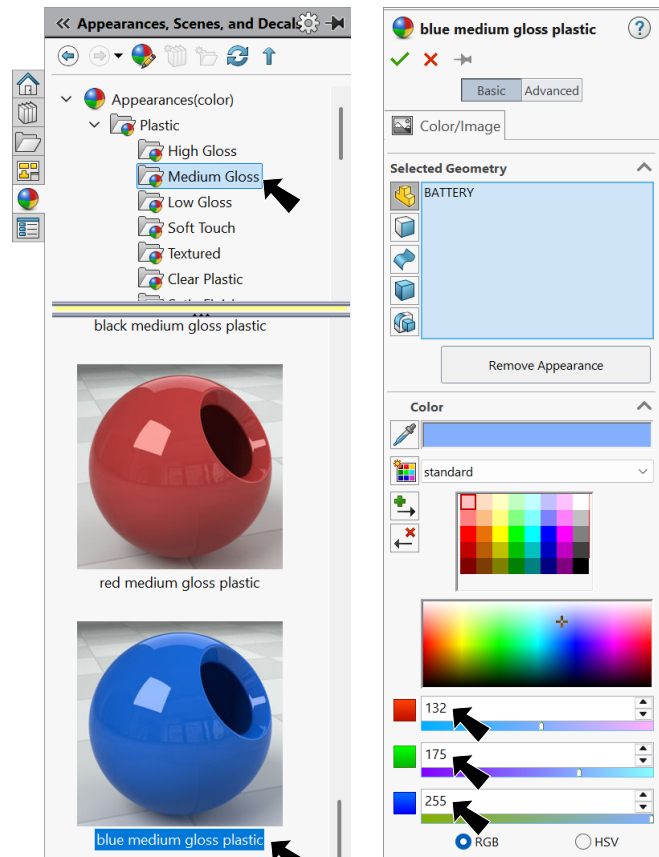


Fig. 72

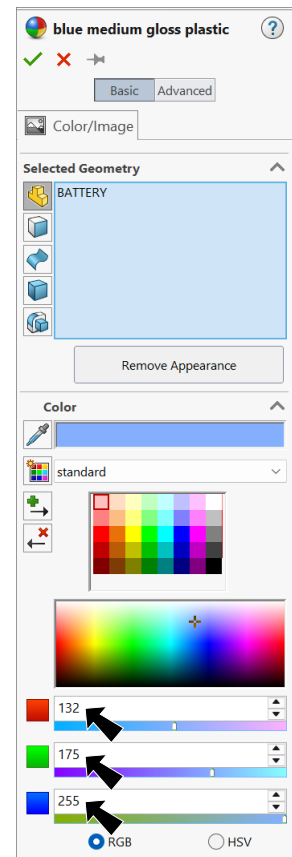


Fig. 73

Step 4. Save  (Ctrl-S).

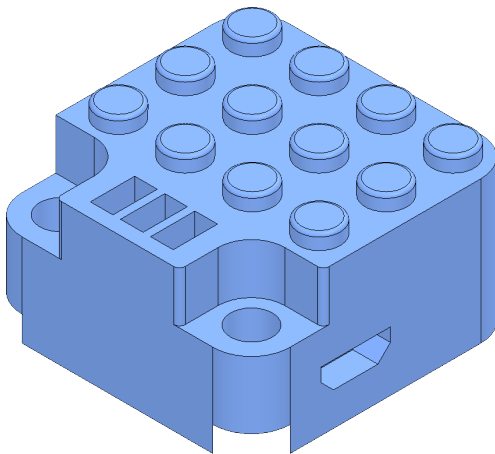


Fig. 74