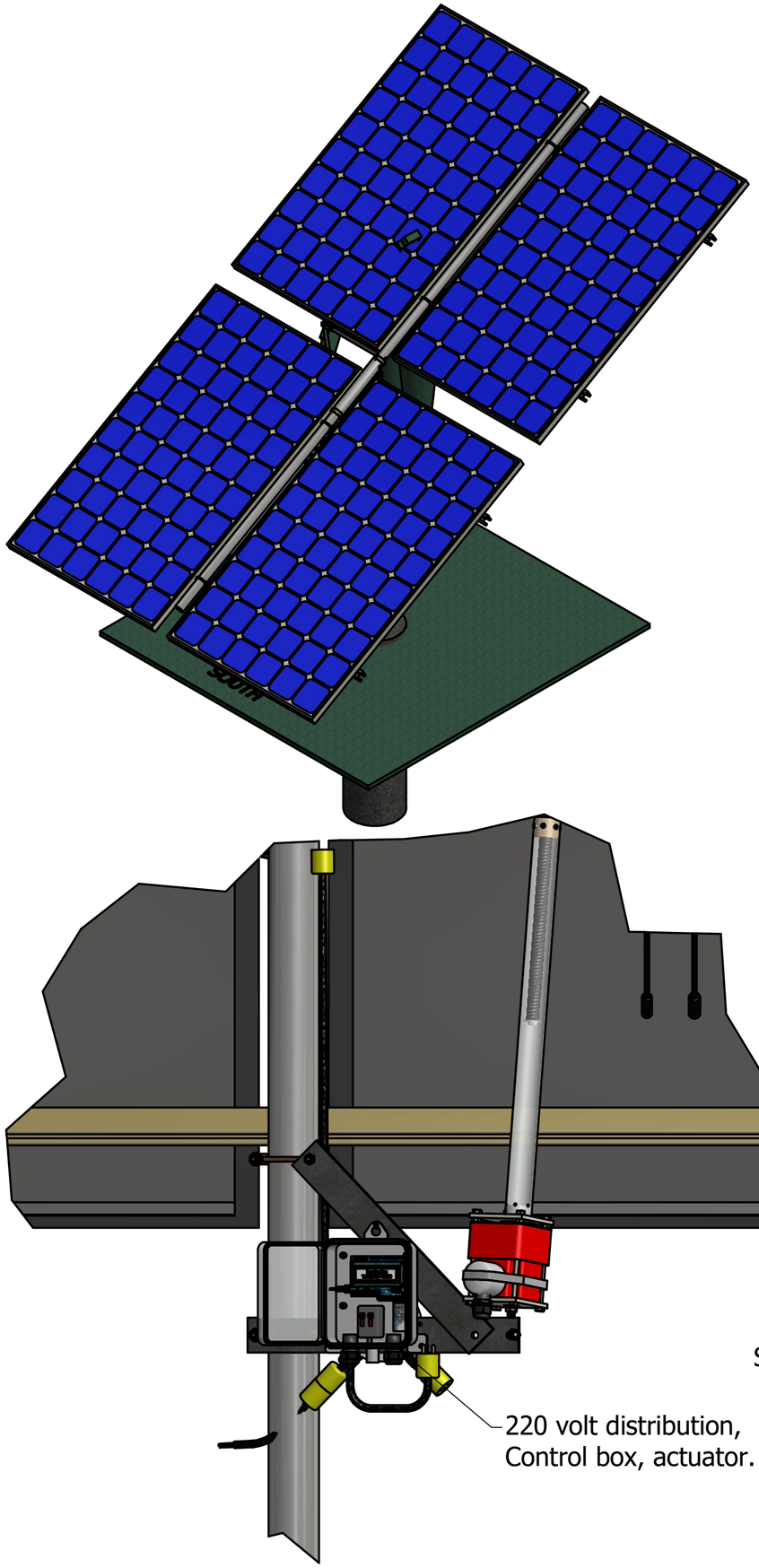
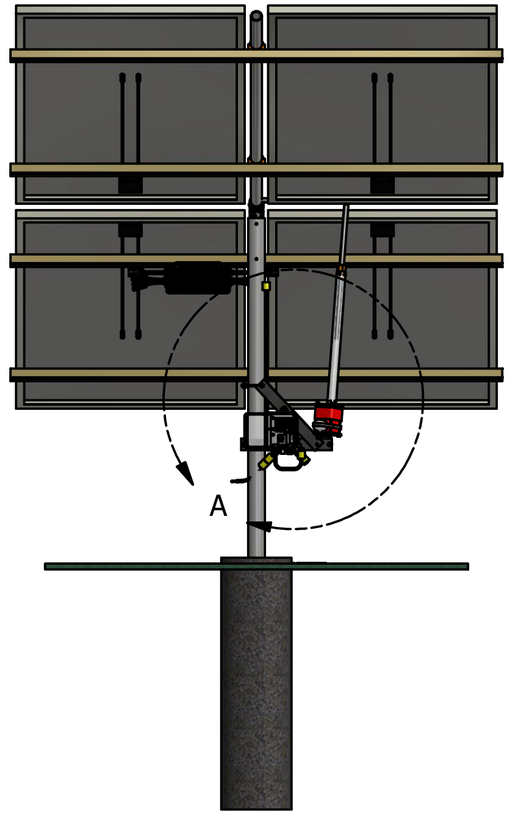


DETAIL A
SCALE 1 / 6

220 volt distribution,
Control box, actuator.



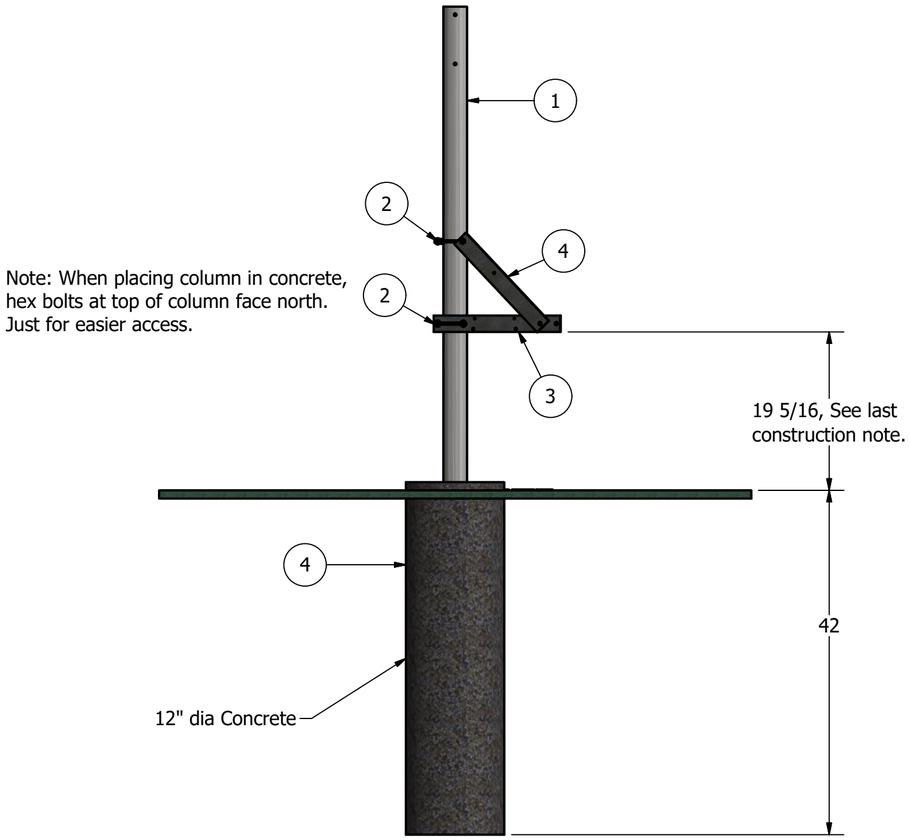
DRAWN Bill Swann	3/7/2016	Watt-Tracker,LLC - Ph 832-338-3080	
CHECKED		TITLE Overall View, 1000 watt tracker	
QA			
MFG			
APPROVED			
		SIZE C	DWG NO 1Axis_Ver2LinAct
		SCALE	SHEET 1 OF 7

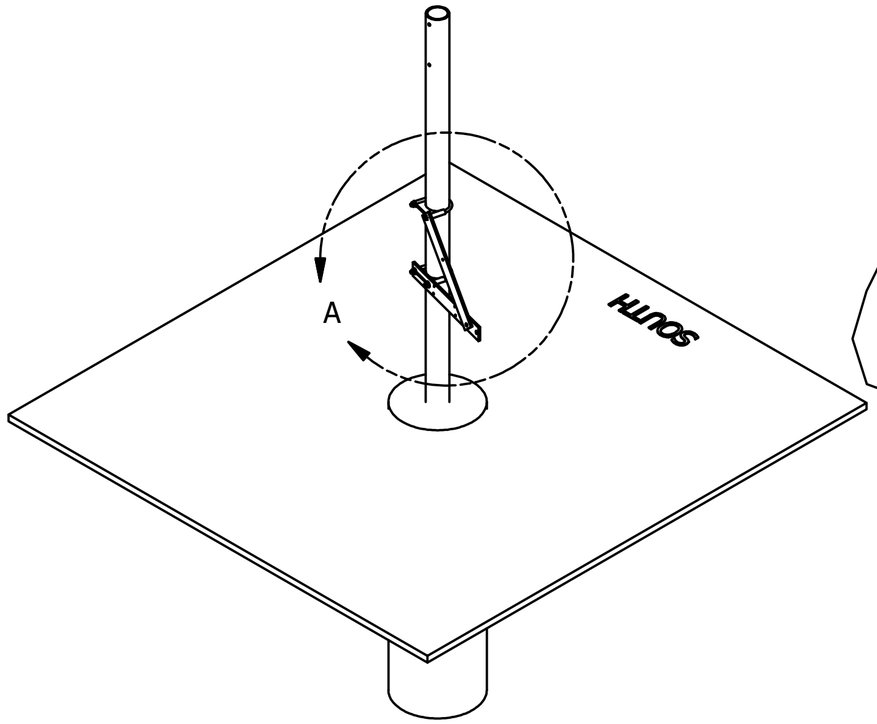
Description, Single Axis tracker
1. The user should be qualified to work with 120 volt / 240 volt systems. The user should follow all code provisions mandated by the building code.
2. This single axis tracker carries 1000 watts of panels with Enphase microinverters. As such, the power connects to a 220 volt, 15 amp breaker in the breaker panel.
The location of the breaker should be on the opposite end of the breaker panel as the 220 volt service feed. Each array will generate 5 amps at 220 volts. If there are more than
2 arrays, the breaker and wire size should be selected accordingly.
3. The array should face south. It is tilted 25° from horizontal, optimizing energy harvested in the summer. The angle could be increased in more northern latitudes. However,
the linkage geometry may have to be tweeked, to prevent binding. Since the bottom panels will be closer to the ground, the column embedded depth may need to be decreased.
4. Tracker movement is controlled with an actuator, made from common components. The stroke can also be changed, but change the EMT and threaded rod equally.
Rotation of the motor is controlled with an Arduino UNO Microcontroller or equivalent. In Houston, they are available at Microcenter, or RadioShak. The 110 volts to the motor is
controlled by a 2 realy board, available fro EBAY, for $5. See the electrical schematic.
5. Alternatevely, an actuator can be purchased from Windy Nation, 16" stroke. In the schematic, an AC relay is replaced by a DC relay. There are some code changes also, to actuate the DC relay.
6. The Arduino code is simple, and works as follows: A real time clock is used to keep the Arduino clock accurate.
The array stores at night time in a horizontal position. At the appointed time the array rotates 40 degrees to the east. In 15 minute intervals, the array rotates to the west.
After 24 moves to the west, the array again levels itself.
7. Building codes in Houston require a lockable disconnect between the array and the breaker box, to protect a power company linemen in a power outtage. Never mind that the inverter,
by specification, does not put power on the line, in the absense of the grid voltage. Never mind that many other states do not require a locakble disconnect. Progress is slow!
One of the hardect tasks in the installation is running the power back to the breaker box. In Houston, it is a buried PVC pipe, in a 18" deep trench. Suggest pulling wire for anticipated growth.
8. The manufacture of the structure requires cutting steel, and welding, and lathe work. The assembly consists of a post set in concrete, At the top is a 5" section of pipe,
that has bearing races machined in - hence making a bearing. The power of the actuator motor is only 8 watts. And it is turned on intermittantly.
Say it is on for 1 minute every 15 minutes. So that 8 watts is 8 x 1 /15 = .5 watt. So .5 watt controlls 1000 watts.
9. The synchronous motor is one of the more pricy components. But a used one can be obtained at Ebay fro $25. A capacitor is required with the motor, and available from
Oriental motor.
10. A 3-D CAD model is viewable at http://www.watt-tracker.com/SingleAxis_1000W.html
11. The designer's e mail is william.swann2@gmail.com. E mail me for copy of the Arduino code.

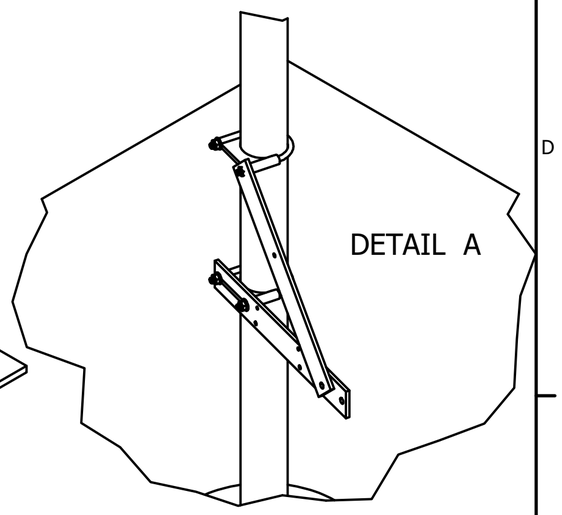
Construction Notes
1. Unistrut length: The unistrut, to which the panels are connected, can be any rust resistant material. Substitutions can be galvanized stop sign posts or 1.5"/1.75" square tubing.
Holes may have to be drilled dependent upon the mounting hole locations on the panels and the clamps.
The overall unistrut length is also dependent upon the size of the panels.
2. The steel pipe structure should be galvanized also. For the top of pipe "T" weldment, grind off the galvanized coating before welding. Coat the weld with cold galvanized spray paint.
3. All materials should be rust resistant. Fasteners can be the plated type.
4. Spar length: This may change dependent upon the panels used. The length is slightly longer than the distance between the outer panel mounting holes, for 2 adjacent panels.
6. Column Embedment: For wind loading, the column is imbedded in the ground in concrete by 30". Make the concrete at ground level higher than the ground, to avoid water pooling.
7. When connecting the T section to the base column, orient the T facing south. Use the 2 bolt clearance holes in the column to D&T 3/8-16 holes in the T section. Screw in 3/8-16 hex bolts.
8. The majority of the part layout can be done with a tape measure or caliper.

Note on locating the actuator mounts: The 2 bars to which the actuator is mounted should be located on the colums as follows. Withe the actuator rod end detatched from the array lever,
adjust the actuador threaed rod to mid stroke, as indicated by the hole in the all thread. Measure the stroke by screwing the all-threadit in and out all the way.
Then level the array. Then position the all-thread to where it is at mid stroke. Attatch the actuator rod end. Adjust the 2 pipe clamps holding the 2 bars to where the array is level.
The purpose of this exercise is to prevent the actuator from bottoming out, either on extension or retraction. If it bottoms out, sometimes it gets stuck.
Also, the initial move or the last move in the PM should also not bottom out the cylinder.

DRAWN Bill Swann	3/7/2016	Watt-Tracker,LLC - Ph 832-338-3080
CHECKED		TITLE: Construction Notes
QA		
MFG		
APPROVED		
		SIZE C / DWG NO 1Axis_Ver2LinAct / REV
		SCALE / SHEET 2 OF 7







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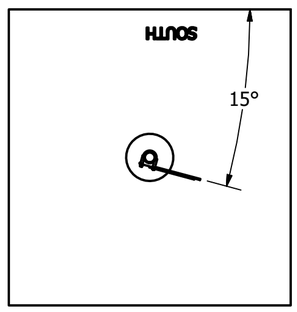
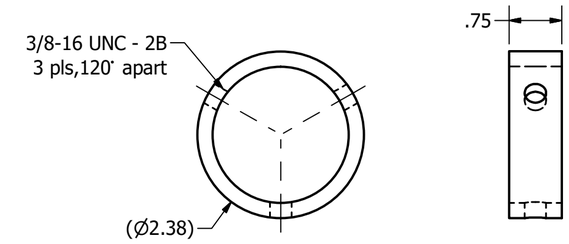
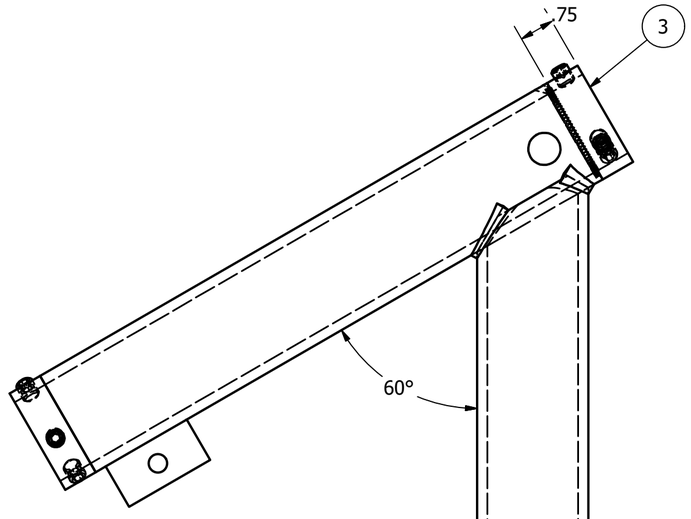


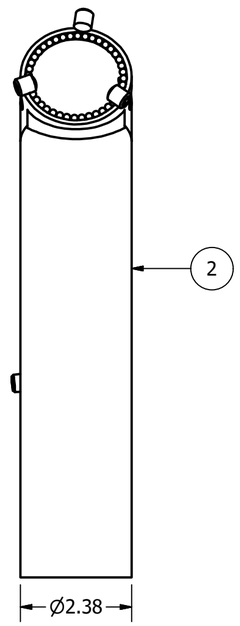
PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	101.000 in	ANSI/AISC Rolled Steel - 2 1/2-101	Pipe Standard Weight
2	2	3042T340	Clamping U Bolt, McMaster-Carr,Zink Plated
3	1	Bar_LowerActuatorMount_Simple	
4	1	Brace_LowerActuatorMount_Simple	

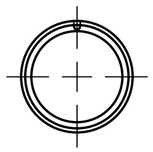
DRAWN Bill Swann	3/7/2016	Watt-Tracker,LLC - Ph 832-338-3080
CHECKED		
QA		TITLE: Base Column
MFG		
APPROVED		SIZE: C; DWG NO: 1Axis_Ver2LinAct; REV:
		SCALE: ; SHEET 3 OF 7

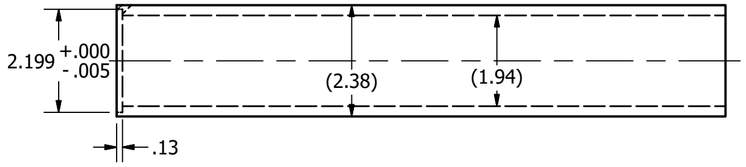
PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	40	McM9529K36	McMaster-Carr,Hardened Stainless Steel Ball, 9/64"
2	10.000 in	ANSI/AISC Rolled Steel - 2-10	Pipe Extra Strong
3	1.500 in	ASME B36.10M Pipe 2 - Schedule 80 - .75	Welded and Seamless Wrought Steel Pipe
4	6	ANSI B18.3 - 3/8-16 UNC x 0.44	Hexagon Socket Set Screw - Oval Point
5	12.500 in	ANSI/AISC Rolled Steel - 2-12.5	Pipe Extra Strong
6	1	Tab_Turnbuckle	Flatbar,0.5" x 1" x 2"

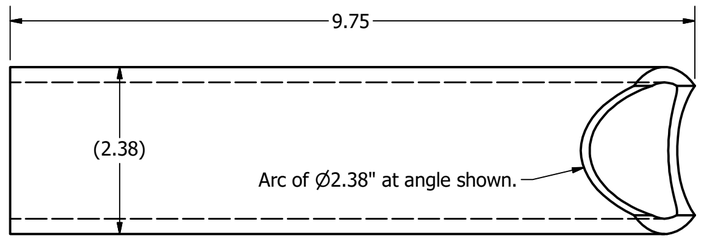


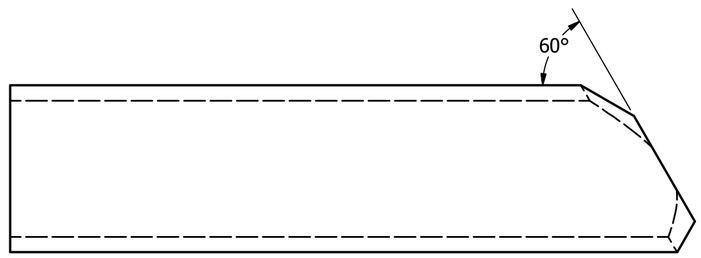


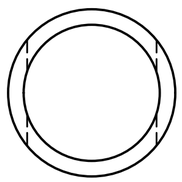








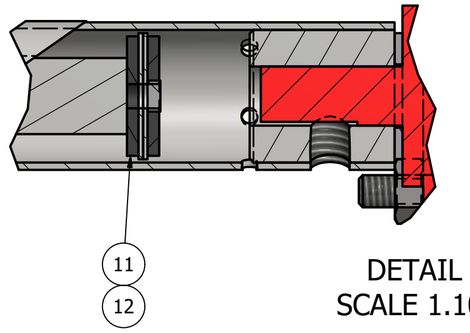




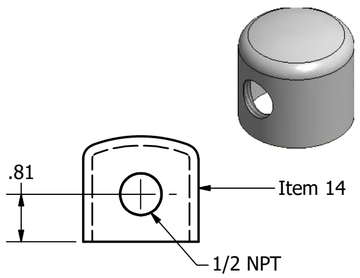
Angle is 90˚ minus latitude.

If placed in more northly latitudes,
this angle can be reduced,
but be careful that the column length
is such that the panel corners do not
contact the ground when gimbled.

DRAWN Bill Swann	3/7/2016	Watt-Tracker,LLC - Ph 832-338-3080
CHECKED		TITLE: Column Top
QA		
MFG		
APPROVED		
SIZE C	DWG NO 1Axis_Ver2LinAct	REV
SCALE	SHEET 4 OF 7	



DETAIL B
SCALE 1.10 : 1



Assembly notes:
1. Connect items 7,8 to threaded shaft. Use loctite.
2. Thread threaded rod into detatched coupling nut, by loosening 4each of a 1/4-20 screw on outboard end.
   Re connect coupling nut with 4 screws with EMT.
3. When connecting EMT to motor shaft, tighten one screw onto motor shaft flat.
   Tighten securely. Tighten remaining 2 screws.
4. Leave a slight gap betreen the asher and EMT. This allows the emt to be pried off the motor shaft for maintenance.
   Prying with a screwdriver against the motor casing will break the housing.

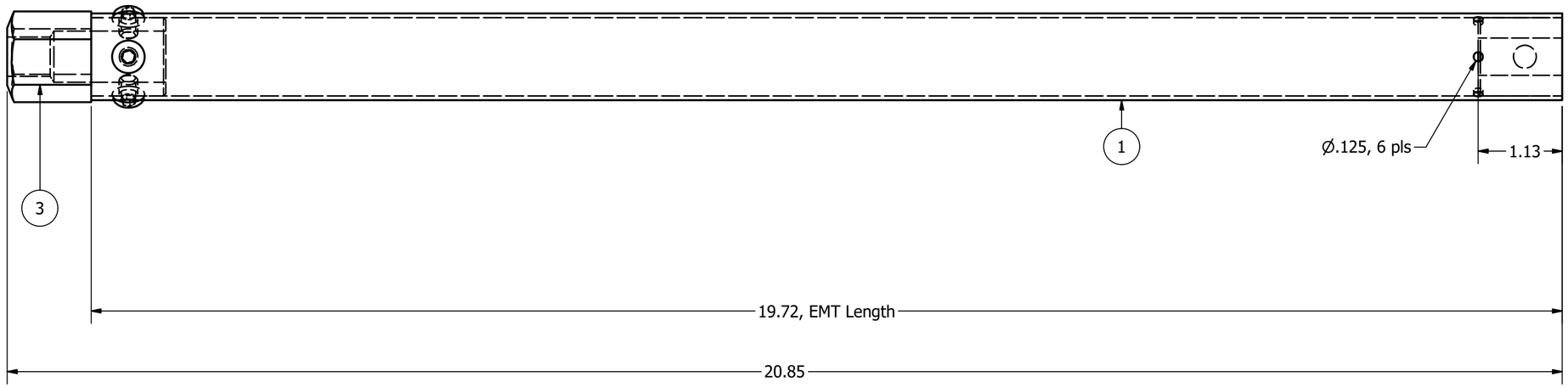
PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	Cap_PVC_1p25	Cap_PVC, 1-1/4" PVC Pipe

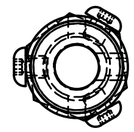
PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	SMK550A_5GN9KA	Oriental Motor,Synchronous gearhead/Ebay $25
2	1	MtgPlate_VextaMotor	Mounting plate,Vexta Motor
3	1	EMT_Rotating_2Adj	EMT Tube with Coupling Nut and Bushing
4	1	Allthread_p62_2Adj	All Thread, 5/8-NC
5	1	RC_Bundle	10 watt resistor/400 ohms ,0.6 mF Cap(250 Volt), in series
6	1	HoseClamp	5", from Home Depot
7	1	60645K141	McMaterr-Carr
9	1	Cap_PVC_1p25	Cap_PVC, 1-1/4" PVC Pipe
10	1	Heyco_p5NPT	Compact Liquid Tight Chord Grip,Heyco_1/2" NPT
11	2	94709A119_NEOPRENE 18-8 SS BONDED SEALING WASHER	McMasterr-Carr
8	1	ANSI B18.22.1 - 1/2 - narrow - Type B	Plain Washer (Inch)Type A and B
12	1	LowHeadCapScrew_10_24	Allen Cap Screw_low head
13	4	ANSI/ASME B18.2.1 - 1/4-20 UNC - 5	Hex Bolt - UNC (Regular Thread - Inch)
14	4	ANSI B18.2.2 - 1/4 - 20	Hex Nuts (Inch Series) Hex Nut
15	1	ANSI B18.2.2 - 3/8 - 24	Hex Nuts (Inch Series) Hex Nut

DRAWN Bill Swann	3/7/2016	Watt-Tracker,LLC - Ph 832-338-3080
CHECKED		TITLE: Actuator
QA		
MFG		
APPROVED		
SIZE: C	DWG NO: 1Axis_Ver2LinAct	REV
SCALE	SHEET 5 OF 7	

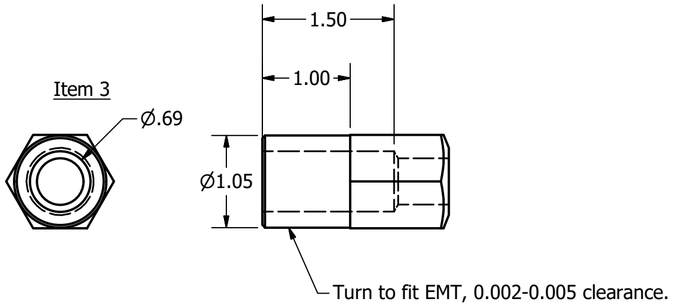
Assembly:
1. Insert coupling nut into EMT. D& T 1/4-20, 3 pls.
2. Place clocking marks on nut and EMT.

Insert chamfer end into bushing. D & T 3/8-16, 1 place.

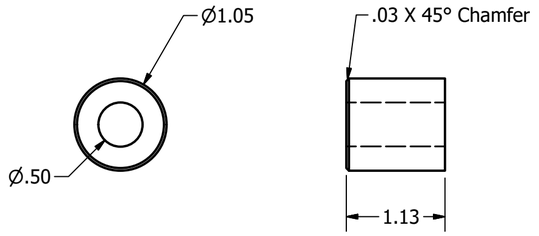


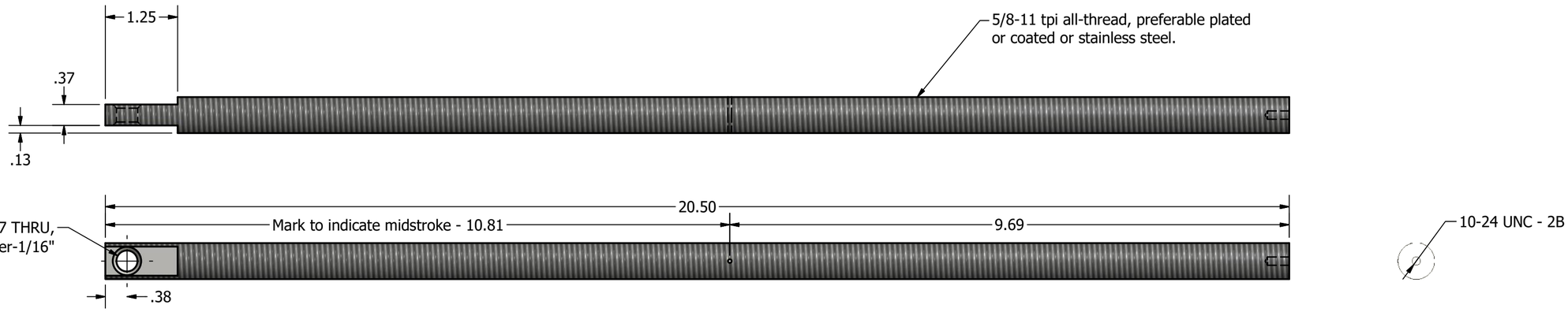


Item 3



Drill bushing 1/2" with drill bit.

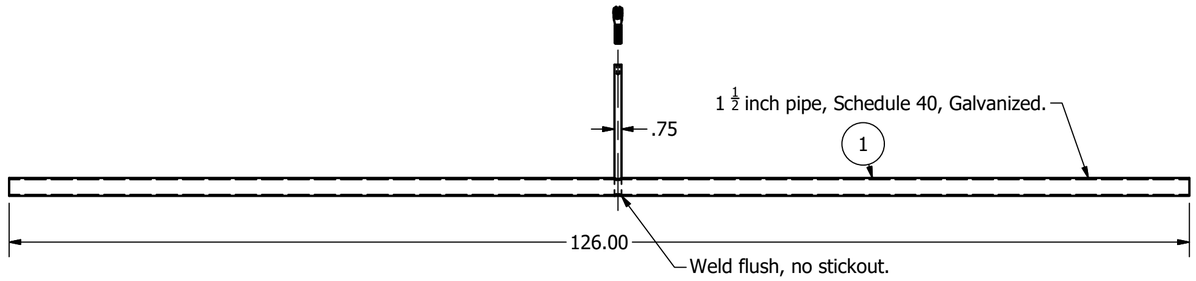


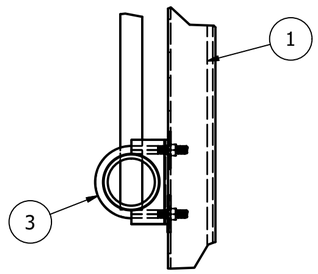


PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	EMT1_2Adj	EMT, 1"
2	1	Bushing_p5x1	Motor Coupling
3	1	MCM90264A231	McMaster-Carr
4	3	ANSI B18.3 - 1/4 - 20 x 3/8	Hexagon Socket Button Head Cap Screw

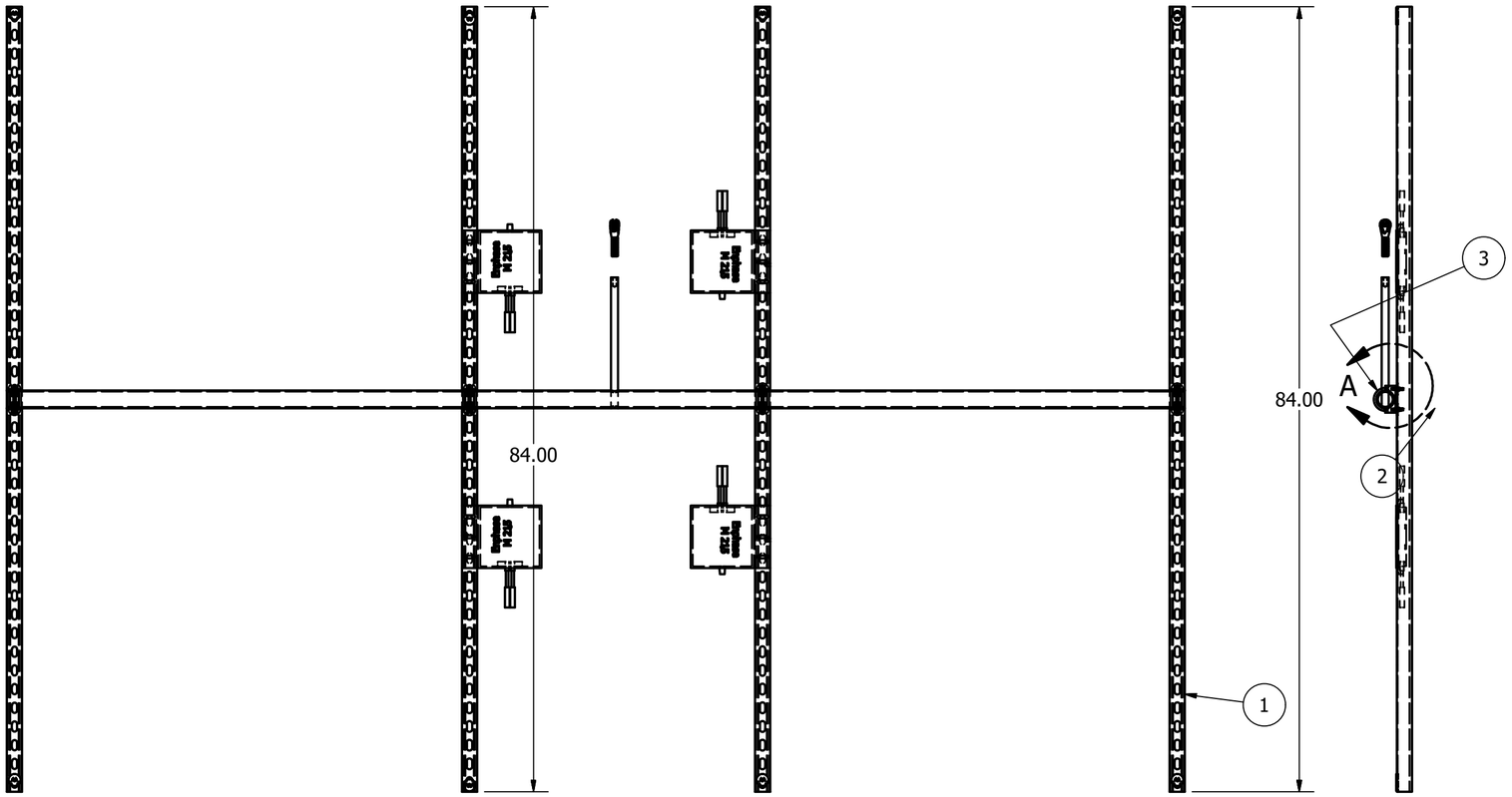
DRAWN Bill Swann	3/7/2016	Watt-Tracker,LLC - Ph 832-338-3080
CHECKED		TITLE: Actuator
QA		
MFG		
APPROVED		
		SIZE C / DWG NO 1Axis_Ver2LinAct / REV
		SCALE / SHEET 6 OF 7

SPAR WELDMENT PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	126.000 in	ANSI/AISC Rolled Steel - 1 1/2-126	Pipe Standard Weight
2	1	TorqueBar_V3	3/4" -NC All Thread, Steel bar x 12" long
3	1	4749T171_MALE SHANK CLEVIS ROD ND	McMaster-Carr

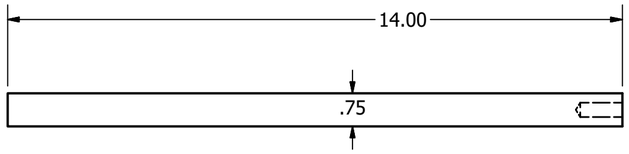




DETAIL A



SPAR PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	A-1200-HalfSlot	Unistrut,1 5/8" with slots
2	1	MainSpar	Weldment
3	4	3042T860	Clamping U Bolt
5	4	REC_TwinPeak280_TP	280 Watt
6	16	FenderWasher	OD-1 1/4,ID-1/4
7	8	FenderWasher_p38x1p25	3/8 ID x 1 1/4 OD
4	4	M215	Enphase Inverter, M215



Notes:
1. Spar is cut to length, with a 1" dia hole, drilled thru, midway.
2. Item 5 is welded, going thru the spar, but no stickout.
3. Unistrut is cut to length with 42 slots. 4 pieces.
4. Attach to main assembly before bolting the Unistrut pieces.
5. Panels have mounting slots. I try to make the spar length long enough to have the unistrut connect to the panel slots. At the same time, the spar length is 21 feet / 2, to avoid a large material drop, the installer may opt to not make the spar length reach the slots, depending upon the panel length. In this case, drill some holes on the panel flanges to use for panel mounting.

DRAWN Bill Swann	3/7/2016	Watt-Tracker,LLC - Ph 832-338-3080
CHECKED		TITLE: Array Spar
QA		
MFG		
APPROVED		SIZE C | DWG NO 1Axis_Ver2LinAct | REV
		SCALE | SHEET 7 OF 7