

**INTRODUCTION:**

THE GOAL OF THE DESERT ROSE BUILDING AUTOMATION SYSTEM IS TO IMPROVE THE QUALITY OF LIFE OF IT'S OCCUPANTS, WHILE ENSURING THE HOUSE MAXIMISES THE SELF CONSUMPTION OF RENEWABLES. DESERT ROSE WILL MAKE USE OF KNX AS ITS PRIMARY BUILDING AUTOMATION PROTOCOL. KNX WAS CHOSEN DUE TO ITS OPEN SOURCE NATURE AND INTEROPERABILITY BETWEEN DEVICES FROM MULTIPLE MANUFACTURERS. ANOTHER ADVANTAGE OF A KNX BUILDING MANAGEMENT SYSTEM (BMS) IS THAT IT CAN BE REPROGRAMMED IF NEED BE TO ADAPT TO THE OCCUPANT. THIS REMOVES THE NEED FOR COMPLEX REWIRING OF THE HOUSE WHICH WOULD BE REQUIRED IN A NORMAL ELECTRICAL INSTALLATION.

IN CONJUNCTION WITH KNX, DESERT ROSE WILL USE INNOVATIVE, LOW COST IOT TECHNOLOGIES WHICH WILL ALL BE INTERFACED WITH THE NODE RED IoT PLATFORM AND AMAZON ECHO. USING NODE RED ALLOWS THE SEAMLESS INTEGRATION OF IoT AND KNX, ALLOWING UOW STUDENTS TO DEVELOP MULTIPLE GRAPHICAL USER INTERFACES THAT ENSURE EASE OF OPERABILITY FOR BOTH THE TECHNOLOGICALLY SAVVY AND ALSO THOSE LIVING WITH AGE RELATED ILLNESSES. ALL KNX AND IoT DEVICES WILL ALSO BE ABLE TO BE OPERATED VIA AMAZON ECHO VOICE CONTROL, PROVIDING FLEXIBILITY FOR OCCUPANTS.

**BATTERY MANAGEMENT STRATEGY:**

THE MAIN ENERGY STRATEGY OF THE DESERT ROSE HOUSE IS TO MAXIMISE THE SELF-CONSUMPTION OF RENEWABLES, RELYING AS LITTLE ON GRID ENERGY AS POSSIBLE (IF AT ALL). THIS WILL BE ACHIEVED USING OPTIMAL CONTROL OF THE SOLAR RESOURCES AND THE ON-SITE ENERGY STORAGE. THE OPTIMAL CONTROL FOR THE BATTERY WAS DEVELOPED BY STUDENTS OF TEAM UOW. THE TECHNIQUE IS KNOWN AS MODEL PREDICTIVE CONTROL (MPC).

THE MPC OPTIMISATION ALGORITHM USES CURRENT DATA FROM THE KNX BMS PREDICTION MODELS OF BOTH SOLAR PV PRODUCTION AND ELECTRICAL LOAD OF THE DESERT ROSE FOR THE NEXT 24 HOURS. BASED ON THIS DATA, THE ALGORITHM DETERMINES THE OPTIMAL CHARGING AND DISCHARGING SCHEDULE OF THE BATTERY, ENSURING AS MUCH SOLAR ENERGY IS USED AS POSSIBLE. THIS OPTIMISATION ALGORITHM IS UPDATED EVERY 15 MINUTES TO ENSURE THE BATTERY IS USING THE MOST UP TO DATE WEATHER AND LOAD DATA (THIS IS THE ADVANTAGE OF MPC OVER REGULAR OPTIMAL CONTROL).




A RASPBERRY PI COMMUNICATES DIRECTLY WITH THE ENERGY STORAGE SYSTEM TO DICTATE THE MAXIMUM CHARGING AND DISCHARGING POWER AT ANY GIVEN TIME. THE RASPBERRY PI COMMUNICATES OVER E3DC IP PROTOCOL RSCP/IP.

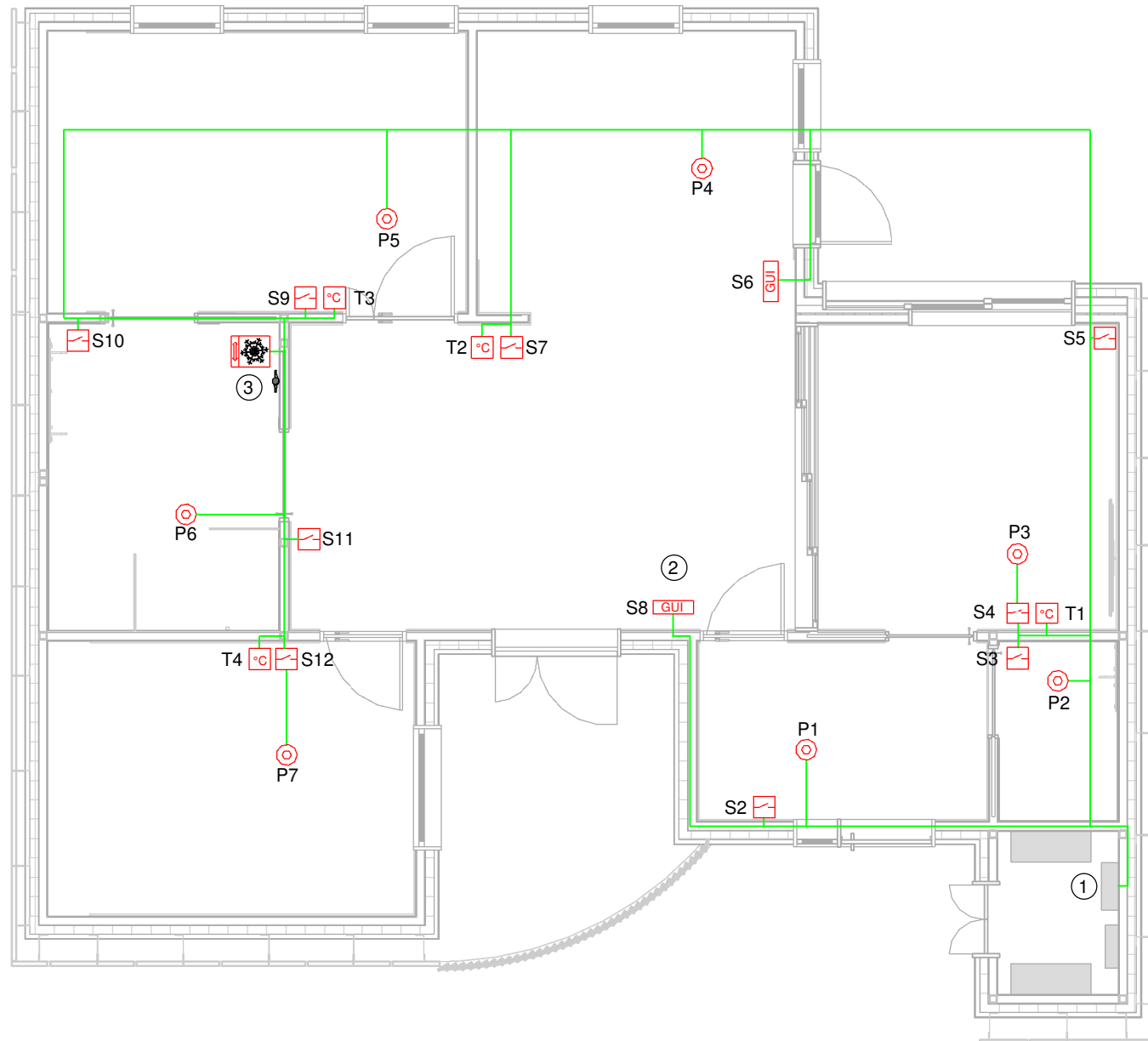
**BLENDING IoT AND BUILDING AUTOMATION**

THE DESERT ROSE HOUSE WILL SEAMLESSLY INTEGRATE IOT AND KNX THROUGH USING THE OPEN SOURCE IOT SERVICE NODE-RED. USING, NODE-RED PROVIDES THE FLEXIBILITY OF CREATING MULTIPLE GRAPHICAL USER INTERFACES FOR OCCUPANTS BASED ON THEIR NEEDS. THE HOUSE WILL HAVE NODE-RED OPERATING ON A RASPBERRY PI CONNECTED TO THE LOCAL IP NETWORK. USING A KNX/IP GATEWAY, IT IS POSSIBLE TO READ AND WRITE TO THE KNX BUS OVER THE MQTT IOT PROTOCOL. THIS WILL ALLOW OCCUPANTS TO OPERATE LIGHTS, WINDOWS, MONITOR ENERGY AND ADJUST THE HVAC SYSTEM

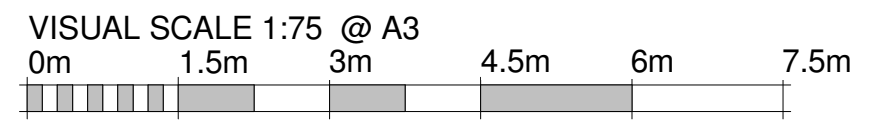
THE TEAM UOW STUDENTS ARE DEVELOPING MULTIPLE IOT TECHNOLOGIES COMMUNICATION OVER MQTT. FIRSTLY, THEY HAVE DEVELOPED AN IOT CONTROLLER THAT CAN OPERATE RGB LED STRIPS LOCATED AT VARIOUS POINTS AROUND THE HOUSE. THIS WILL PROMOTE HEALTH AND WELL-BEING TO THE OCCUPANTS THROUGHOUT THE HOUSE. STUDENTS DEVELOPED 'SMART' PLUMBING FIXTURES WITH ELECTRONIC THERMOSTATIC MIXING OPERATED BY RASPBERRY PI'S. THIS WILL ALLOW OCCUPANTS TO DYNAMICALLY CHANGE THE OPERATING TEMPERATURE OF FIXTURES AND EVEN TURN THEM OFF VIA THE BMS. FINALLY, THE HOUSE WILL INCORPORATE WIFI CONTROLLED SMART SWITCHES THAT WILL BE ABLE TO TURN OFF ANY STANDBY LOADS AND OPERATE CERTAIN APPLIANCES TO OPERATE WHEN THERE IS SUFFICIENT SOLAR RESOURCE.



 <p><b>Desert Rose</b> Team UOW Australia - Dubai</p>	<p><b>Team:</b> TEAM UOW</p>	<p><b>Client:</b></p>  <p>Dubai Electricity and Water Authority</p> 	<p><b>AMENDMENTS</b></p> <table border="1"> <thead> <tr> <th>REV.</th> <th>DESCRIPTION</th> <th>DATE</th> <th>DRAWN</th> <th>CHECK</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Updated to As-Built</td> <td>14/09/18</td> <td>BB</td> <td>CM</td> </tr> </tbody> </table>				REV.	DESCRIPTION	DATE	DRAWN	CHECK	1	Updated to As-Built	14/09/18	BB	CM	<p><b>COPYRIGHT</b></p> <p>None; Project is Public</p>		<p><b>DESCRIPTION AND FEATURES</b></p> <p><b>BAS-001</b></p>
	REV.		DESCRIPTION	DATE	DRAWN	CHECK													
1	Updated to As-Built	14/09/18	BB	CM															
<p><b>Address:</b> UNIVERSITY OF WOLLONGONG WOLLONGONG NSW, AUSTRALIA 2522</p>	<p><b>Contact:</b> sd-2018@uow.edu.au www.desertrosehouse.com.au</p>	<p>LOT # M</p> <p>DRAWER B. BANFIELD</p> <p>CHECKED C.MCDOWELL</p> <p>DATE 20 February, 2018</p> <p>SCALE N.T.S. @ A3</p>	<p>SHEET: 01 OF 01</p>																



- NOTES**
- FOR AUTOMATION EQUIPMENT AND LEGEND REFER TO BAS-301
  - FOR SWITCHING GROUPS REFER TO EL-201
  - FOR CONTROLLERS INSTALLED IN DESERT ROSE MAIN ELECTRICAL PANEL, REFER TO BAS-201
  - S# TAG DENOTES KNX SWITCH NUMBER. SWITCHES INSTALLED 1100mm ABOVE FLOOR LEVEL. REFER TO BAS-301 FOR SWITCH DETAILS. REFER TO EL-201 FOR LIGHTING DETAILS.
  - T# TAG DENOTES KNX TEMPERATURE, RELATIVE HUMIDITY AND CO2 SENSOR. SENSORS INSTALLED 1100mm ABOVE FLOOR LEVEL. REFER TO BAS-301 FOR SENSOR DETAILS. REFER TO ME-231 FOR HVAC CONTROL DETAILS.
  - P# TAG DENOTES KNX PRESENCE/ LUX SENSOR. SENSORS TO BE INSTALLED FLUSH IN CEILING. REFER TO BAS-301 FOR SENSOR DETAILS.
  - KNX BUS CABLE INSTALLED ON CABLE TRAY IN CEILING CAVITY. CABLES TERMINATE AT WALL SWITCHES AND SENSORS VIA 25mm CONDUIT IN WALL CAVITIES
  - 1. BUILDING AUTOMATION DIN RAIL ENCLOSURE CONTAINING KNX POWER SUPPLY AND ACTUATORS. ALL KNX INPUT DEVICES CONNECTED DOWNSTREAM FROM BOARD. REFER TO BAS-201 FOR INFO ON ADDITIONAL KNX DEVICES LOCATED IN BOARD.
  - 2. GRAPHICAL USER INTERFACE INSTALLED FLUSH MOUNTED IN WALL. REFER TO BAS-301 FOR INTERFACE DETAILS.
  - 3. SIEMENS PXC3.E75-100A HVAC CONTROLLER INSTALLED IN TOP OF LAUNDRY CUPBOARD. FOR CONNECTION DETAILS REFER TO ME-233



# KNX Wiring

1  
1 : 75

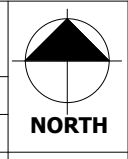


**Team:** TEAM UOW  
**Address:** UNIVERSITY OF WOLLONGONG  
 WOLLONGONG  
 NSW, AUSTRALIA 2522  
**Contact:** sd-2018@uow.edu.au  
 www.desertrosehouse.com.au

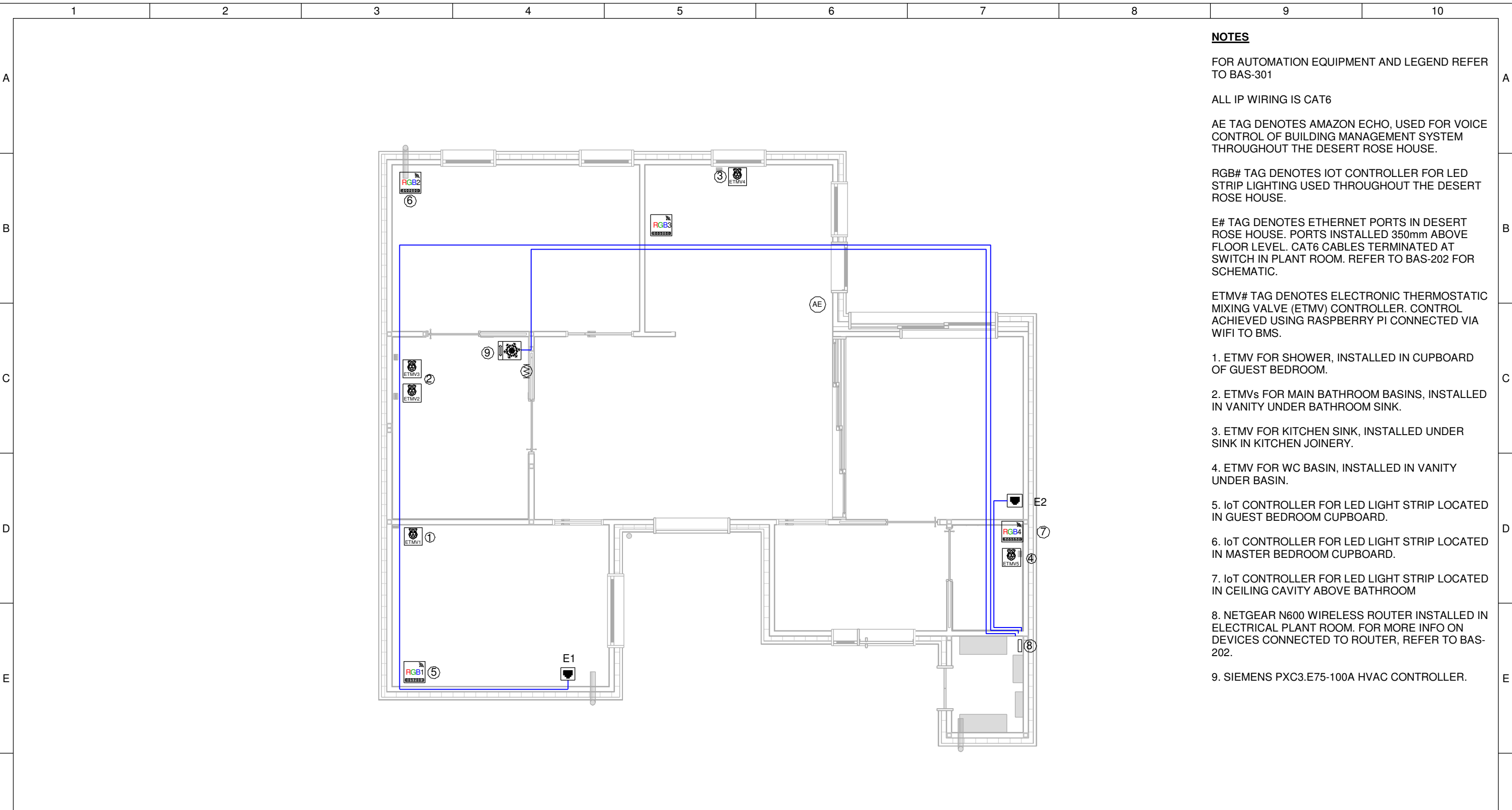
**Client:** Dubai Electricity and Water Authority

AMENDMENTS					
REV.	DESCRIPTION	DATE	DRAWN	CHECK	
1	Updated Plans, Detailing and Template Adjustments	20/01/18	VP	JR	
2	Updated to As-Built	14/09/18	BB	CM	

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CHECKED V.PHAM	
DATE 18 January, 2018	
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**AUTOMATION WIRING PLAN (KNX)**  
**BAS-101**  
 SHEET: 01 OF 01



**NOTES**

FOR AUTOMATION EQUIPMENT AND LEGEND REFER TO BAS-301

ALL IP WIRING IS CAT6

AE TAG DENOTES AMAZON ECHO, USED FOR VOICE CONTROL OF BUILDING MANAGEMENT SYSTEM THROUGHOUT THE DESERT ROSE HOUSE.

RGB# TAG DENOTES IOT CONTROLLER FOR LED STRIP LIGHTING USED THROUGHOUT THE DESERT ROSE HOUSE.

E# TAG DENOTES ETHERNET PORTS IN DESERT ROSE HOUSE. PORTS INSTALLED 350mm ABOVE FLOOR LEVEL. CAT6 CABLES TERMINATED AT SWITCH IN PLANT ROOM. REFER TO BAS-202 FOR SCHEMATIC.

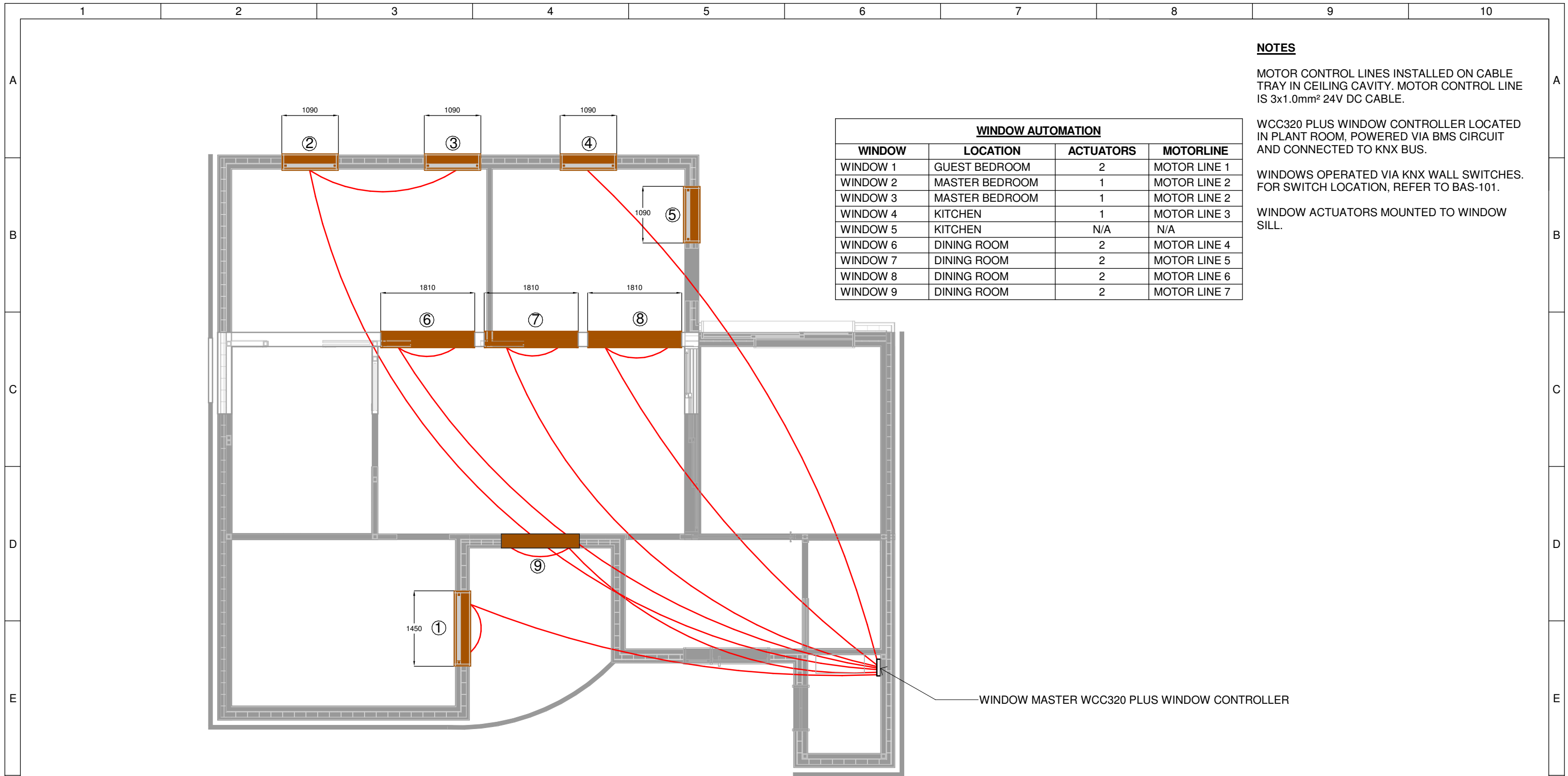
ETMV# TAG DENOTES ELECTRONIC THERMOSTATIC MIXING VALVE (ETMV) CONTROLLER. CONTROL ACHIEVED USING RASPBERRY PI CONNECTED VIA WIFI TO BMS.

1. ETMV FOR SHOWER, INSTALLED IN CUPBOARD OF GUEST BEDROOM.
2. ETMVs FOR MAIN BATHROOM BASINS, INSTALLED IN VANITY UNDER BATHROOM SINK.
3. ETMV FOR KITCHEN SINK, INSTALLED UNDER SINK IN KITCHEN JOINERY.
4. ETMV FOR WC BASIN, INSTALLED IN VANITY UNDER BASIN.
5. IoT CONTROLLER FOR LED LIGHT STRIP LOCATED IN GUEST BEDROOM CUPBOARD.
6. IoT CONTROLLER FOR LED LIGHT STRIP LOCATED IN MASTER BEDROOM CUPBOARD.
7. IoT CONTROLLER FOR LED LIGHT STRIP LOCATED IN CEILING CAVITY ABOVE BATHROOM
8. NETGEAR N600 WIRELESS ROUTER INSTALLED IN ELECTRICAL PLANT ROOM. FOR MORE INFO ON DEVICES CONNECTED TO ROUTER, REFER TO BAS-202.
9. SIEMENS PXC3.E75-100A HVAC CONTROLLER.

**1 IP Wiring**  
1 : 75



	<b>Team:</b> TEAM UOW <b>Address:</b> UNIVERSITY OF WOLLONGONG WOLLONGONG NSW, AUSTRALIA 2522 <b>Contact:</b> sd-2018@uow.edu.au www.desertrosehouse.com.au	<b>Client:</b> Dubai Electricity and Water Authority 	<b>AMENDMENTS</b> <table border="1"> <thead> <tr> <th>REV.</th> <th>DESCRIPTION</th> <th>DATE</th> <th>DRAWN</th> <th>CHECK</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Updated to As-Built</td> <td>14/09/18</td> <td>BB</td> <td>CM</td> </tr> </tbody> </table>	REV.	DESCRIPTION	DATE	DRAWN	CHECK	1	Updated to As-Built	14/09/18	BB	CM	<b>COPYRIGHT</b> None; Project is Public LOT # M DRAWER B.BANFIELD CHECKED V.PHAM DATE 20 February, 2018 SCALE 1 : 75 @ A3	 <b>NORTH</b> SHEET: 01 OF 01	<b>AUTOMATION WIRING (IP)</b> <h1>BAS-102</h1>
	REV.	DESCRIPTION	DATE	DRAWN	CHECK											
1	Updated to As-Built	14/09/18	BB	CM												
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WINDOW AUTOMATION			
WINDOW	LOCATION	ACTUATORS	MOTORLINE
WINDOW 1	GUEST BEDROOM	2	MOTOR LINE 1
WINDOW 2	MASTER BEDROOM	1	MOTOR LINE 2
WINDOW 3	MASTER BEDROOM	1	MOTOR LINE 2
WINDOW 4	KITCHEN	1	MOTOR LINE 3
WINDOW 5	KITCHEN	N/A	N/A
WINDOW 6	DINING ROOM	2	MOTOR LINE 4
WINDOW 7	DINING ROOM	2	MOTOR LINE 5
WINDOW 8	DINING ROOM	2	MOTOR LINE 6
WINDOW 9	DINING ROOM	2	MOTOR LINE 7

**NOTES**

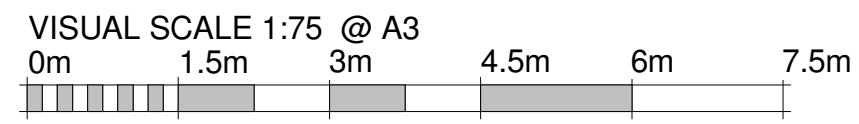
MOTOR CONTROL LINES INSTALLED ON CABLE TRAY IN CEILING CAVITY. MOTOR CONTROL LINE IS 3x1.0mm<sup>2</sup> 24V DC CABLE.

WCC320 PLUS WINDOW CONTROLLER LOCATED IN PLANT ROOM, POWERED VIA BMS CIRCUIT AND CONNECTED TO KNX BUS.

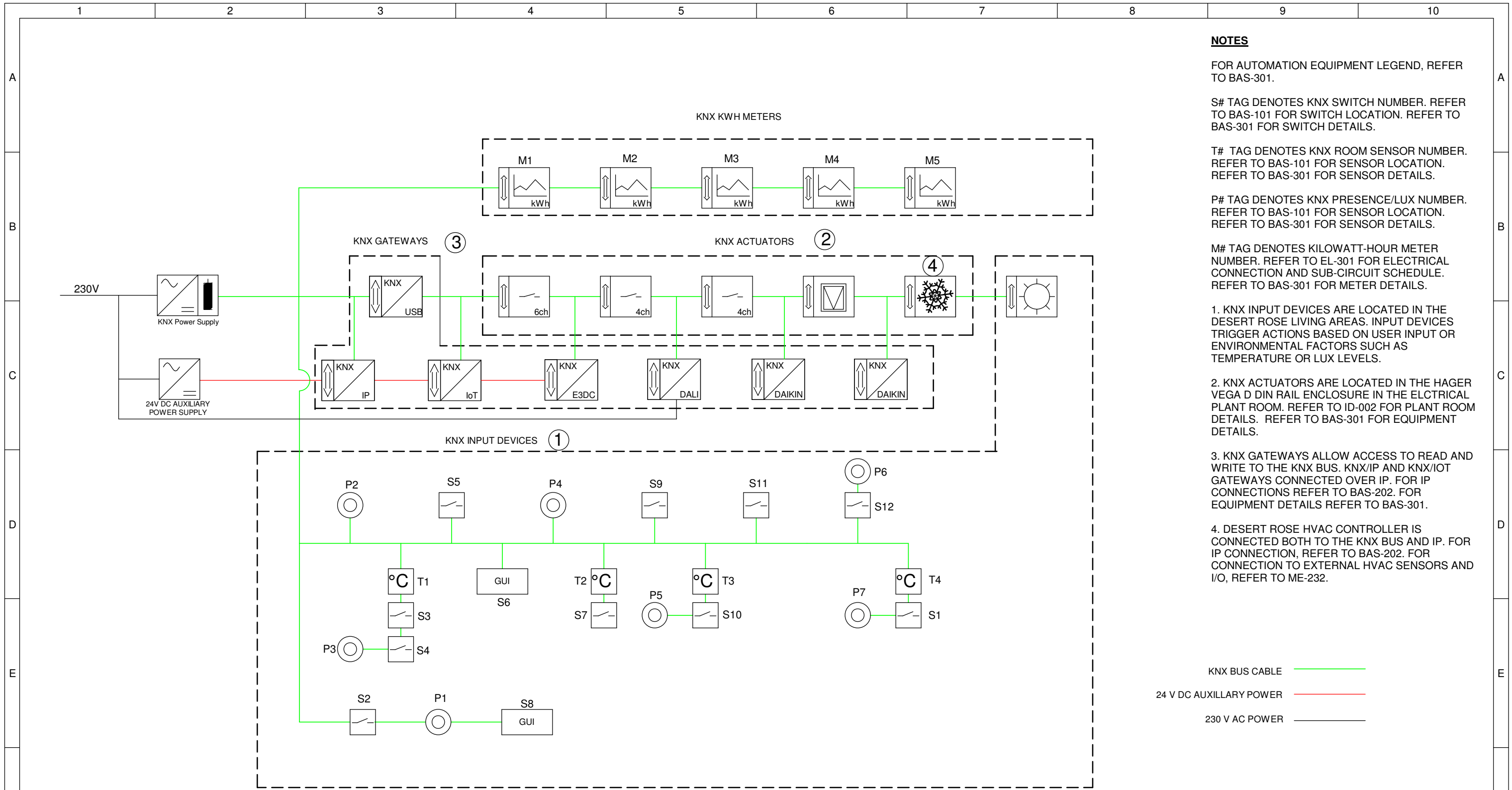
WINDOWS OPERATED VIA KNX WALL SWITCHES. FOR SWITCH LOCATION, REFER TO BAS-101.

WINDOW ACTUATORS MOUNTED TO WINDOW SILL.

**1** Window Wiring  
1 : 75



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	REV.	DESCRIPTION	DATE	DRAWN	CHECK										
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**NOTES**

FOR AUTOMATION EQUIPMENT LEGEND, REFER TO BAS-301.

S# TAG DENOTES KNX SWITCH NUMBER. REFER TO BAS-101 FOR SWITCH LOCATION. REFER TO BAS-301 FOR SWITCH DETAILS.

T# TAG DENOTES KNX ROOM SENSOR NUMBER. REFER TO BAS-101 FOR SENSOR LOCATION. REFER TO BAS-301 FOR SENSOR DETAILS.

P# TAG DENOTES KNX PRESENCE/LUX NUMBER. REFER TO BAS-101 FOR SENSOR LOCATION. REFER TO BAS-301 FOR SENSOR DETAILS.

M# TAG DENOTES KILOWATT-HOUR METER NUMBER. REFER TO EL-301 FOR ELECTRICAL CONNECTION AND SUB-CIRCUIT SCHEDULE. REFER TO BAS-301 FOR METER DETAILS.

1. KNX INPUT DEVICES ARE LOCATED IN THE DESERT ROSE LIVING AREAS. INPUT DEVICES TRIGGER ACTIONS BASED ON USER INPUT OR ENVIRONMENTAL FACTORS SUCH AS TEMPERATURE OR LUX LEVELS.

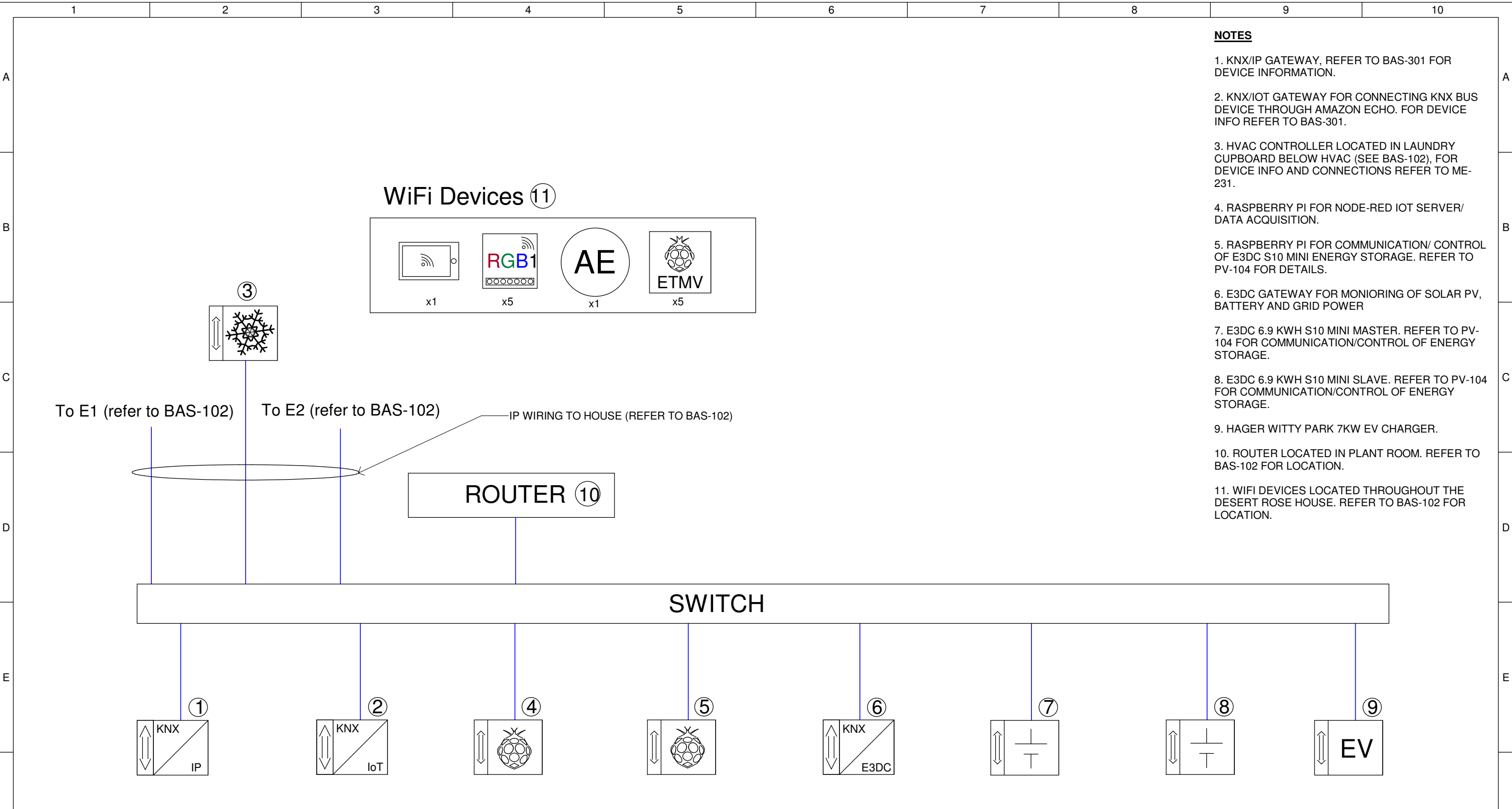
2. KNX ACTUATORS ARE LOCATED IN THE HAGER VEGA D DIN RAIL ENCLOSURE IN THE ELECTRICAL PLANT ROOM. REFER TO ID-002 FOR PLANT ROOM DETAILS. REFER TO BAS-301 FOR EQUIPMENT DETAILS.

3. KNX GATEWAYS ALLOW ACCESS TO READ AND WRITE TO THE KNX BUS. KNX/IP AND KNX/IOT GATEWAYS CONNECTED OVER IP. FOR IP CONNECTIONS REFER TO BAS-202. FOR EQUIPMENT DETAILS REFER TO BAS-301.

4. DESERT ROSE HVAC CONTROLLER IS CONNECTED BOTH TO THE KNX BUS AND IP. FOR IP CONNECTION, REFER TO BAS-202. FOR CONNECTION TO EXTERNAL HVAC SENSORS AND I/O, REFER TO ME-232.

## Schematic Diagram and Interfaces (KNX)

	<b>Team:</b> TEAM UOW <b>Address:</b> UNIVERSITY OF WOLLONGONG WOLLONGONG NSW, AUSTRALIA 2522 <b>Contact:</b> sd-2018@uow.edu.au www.desertrosehouse.com.au	<b>Client:</b> Dubai Electricity and Water Authority 	<b>AMENDMENTS</b> <table border="1"> <thead> <tr> <th>REV.</th> <th>DESCRIPTION</th> <th>DATE</th> <th>DRAWN</th> <th>CHECK</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Updated to As-Built</td> <td>14/09/18</td> <td>BB</td> <td>CM</td> </tr> </tbody> </table>	REV.	DESCRIPTION	DATE	DRAWN	CHECK	1	Updated to As-Built	14/09/18	BB	CM	<b>COPYRIGHT</b> None; Project is Public LOT # M DRAWER B.BANFIELD CHECKED V.PHAM DATE 12 May, 2018 SCALE N.T.S. @ A3	<b>SCH. DIAGRAM AND INTERFACES (KNX)</b> <b>BAS-201</b> SHEET: 01 OF 01
	REV.	DESCRIPTION	DATE	DRAWN	CHECK										
1	Updated to As-Built	14/09/18	BB	CM											



- NOTES**
1. KNX/IP GATEWAY, REFER TO BAS-301 FOR DEVICE INFORMATION.
  2. KNX/IOT GATEWAY FOR CONNECTING KNX BUS DEVICE THROUGH AMAZON ECHO. FOR DEVICE INFO REFER TO BAS-301.
  3. HVAC CONTROLLER LOCATED IN LAUNDRY CUPBOARD BELOW HVAC (SEE BAS-102), FOR DEVICE INFO AND CONNECTIONS REFER TO ME-231.
  4. RASPBERRY PI FOR NODE-RED IOT SERVER/ DATA ACQUISITION.
  5. RASPBERRY PI FOR COMMUNICATION/ CONTROL OF E3DC S10 MINI ENERGY STORAGE. REFER TO PV-104 FOR DETAILS.
  6. E3DC GATEWAY FOR MONIORING OF SOLAR PV, BATTERY AND GRID POWER
  7. E3DC 6.9 KWH S10 MINI MASTER. REFER TO PV-104 FOR COMMUNICATION/CONTROL OF ENERGY STORAGE.
  8. E3DC 6.9 KWH S10 MINI SLAVE. REFER TO PV-104 FOR COMMUNICATION/CONTROL OF ENERGY STORAGE.
  9. HAGER WITTY PARK 7KW EV CHARGER.
  10. ROUTER LOCATED IN PLANT ROOM. REFER TO BAS-102 FOR LOCATION.
  11. WIFI DEVICES LOCATED THROUGHOUT THE DESERT ROSE HOUSE. REFER TO BAS-102 FOR LOCATION.

## Schematic Diagram and Interfaces (Internal Protocol)

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	REV.	DESCRIPTION	DATE	DRAWN	CHECK											
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DEVICE	MAKE	MODEL	QUANTITY	SYMBOL
POWER SUPPLY 30V DC 640 mA	HAGER	TXA112	1	
POWER SUPPLY 24 V DC 1A	HAGER	TGA200	1	
MODULAR USB INTERFACE	HAGER	TH101	1	
ROUTER IP/KNX	HAGER	TH210	1	
KNX IoT GATEWAY	HAGER	TJA560	1	
PRESENCE/ LUX SENSOR. 360° MONOBLOC KNX	HAGER	TCC520E	7	
3PH kWh METER	HAGER	TE311	5	
KNX WALL MOUNTED SWITCH AND BUS COUPLING UNIT FLUSH-MOUNTED	BERKER	B.IQ IN POLAR WHITE	9	
WALL MOUNTED ETHERNET PORT	CLIPSAL	30RJ45SMA6	2	
WEATHER SATATION	GIRA	WEATHER STATION PLUS	1	

DEVICE	MAKE	MODEL	QUANTITY	SYMBOL
10A 6 CHANNEL RELAY	HAGER	TYA606B	1	
16A 4 CHANNEL RELAY	HAGER	TYA604C	2	
KNX/E3DC GATEWAY	E3DC	KNX CONNECT	1	
KNX/DALI GATEWAY	HAGER	TYA670D	1	
WINDOW CONTROLLER	WINDOW MASTER	WCC 320PLUS	1	
HVAC CONTROLLER	SIEMENS	PXC3. E75-100A	1	
VOICE CONTROL	AMAZON	ECHO	1	
ELECTRONIC THERMOSTATIC MIXING VALV (RASPBERRY PI)	RASPBERRY PI	PI 3	5	
IOT RGB LIGHTING CONTROLLER	(STUDENT MADE)	N/A	4	
RASPBERRY PI	RASPBERRY PI	PI 3	2	
TABLET INTERFACE	SAMSUNG	TAB S3 9.7"	1	
KNX/DAIKIN GATEWAY	INTESISBOX	DK-RC-KNX-1	2	
NETWORK SWITCH	D-LINK	DGS-1016A	1	N/A
NETWORK ROUTER	NETGEAR	DGND370	1	N/A

## Equipment



**Desert Rose**  
Team UOW  
Australia - Dubai

Team: TEAM UOW

Address: UNIVERSITY OF WOLLONGONG  
WOLLONGONG  
NSW, AUSTRALIA 2522

Contact: sd-2018@uow.edu.au  
www.desertrosehouse.com.au

Client:

Dubai Electricity and Water Authority



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SCALE @ A3

**EQUIPMENT  
SCHEDULE/  
LEGEND**

SHEET:

**BAS-301**  
12 May 2018 01 of 01  
N.T.S.