# NSLS-II 1-Wire System

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# Tasks

- **Power supply temperature monitor:**
  → 144 sensors per rack group: approximate 9 power supplies, each PS contains 16 sensors. 3 PS rack group.
  → 144 * 3 racks/cell *30 cells = 12,960

- **Magnet temperature(recently implemented) monitor:**
  → 60 sensors per cell. 30 cells.
  → 60 * 30 =1800

- **Monitors power supply 3Φ AC input current:**
  → 18 sensors/rack. 4 rack/group, 3 rack group for PS system (RGA to RGC)
  → 18 * 4 * 3 * 30 = 6,48

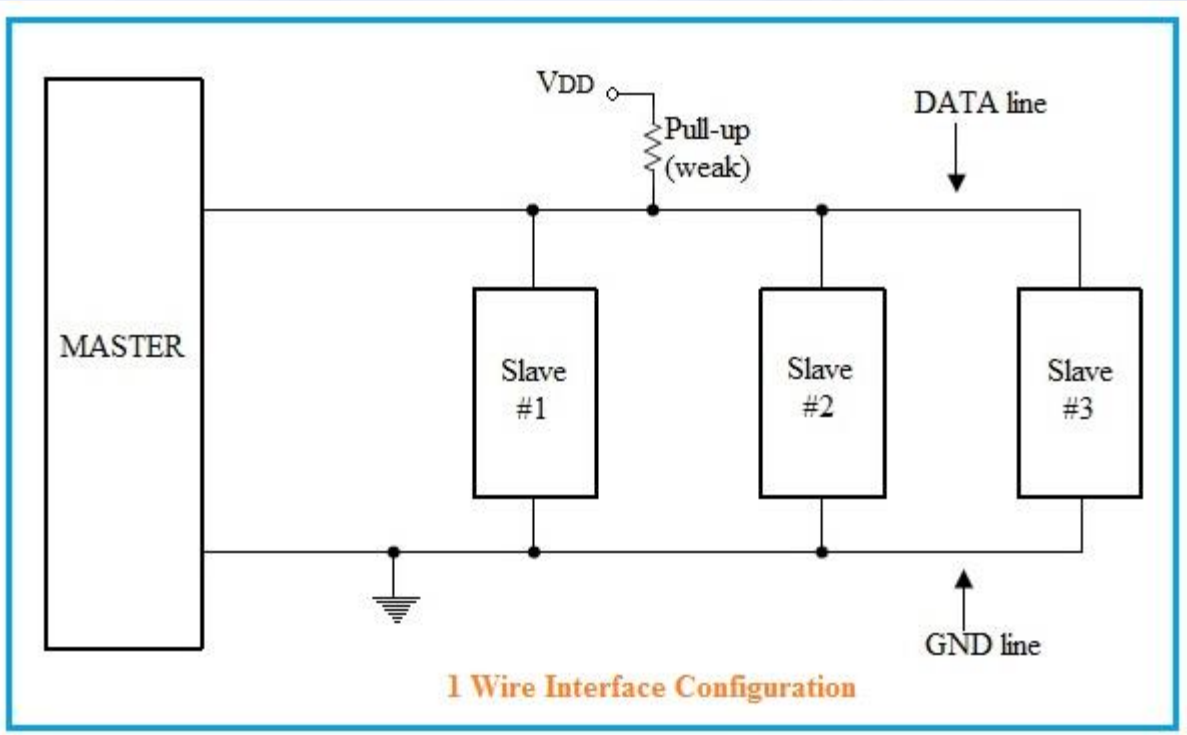
- **Resets RCU micro and PSI FPGA to power up state:**
  → 12 Reset switch per rack.
  → 12 * 4 * 3 * 30 = 4,320

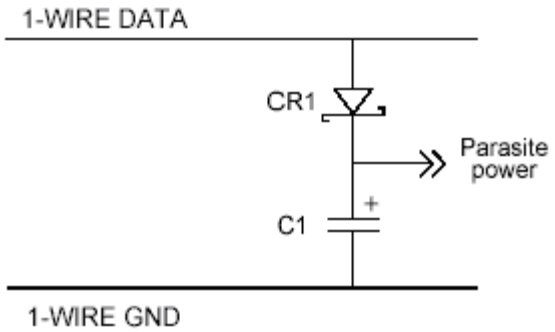
- **Rack temperature and humidity monitor: (for all rack groups)**
  → 4 per rack group. 6 rack group per cell: RGA to RGF.
  → 4 * 6 * 30 = 720

**Total sensor counts: about 26,280.**

How to accomplish this tasks with low cost ?
RTD costs about $30/sensor → too expensive.

# 1-Wire System: Device and Network



# NSLS-II 1-Wire System: 1st Generation

EMBEDDED DATA SYSTEMS

## HA5-User Manual

ASCII RS232/RS485/TTL to 1-Wire® Host Adapter

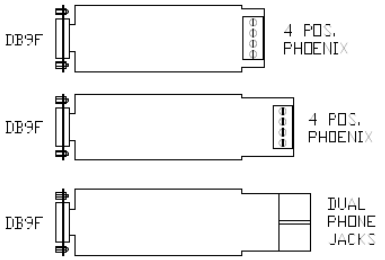
http://www.EmbeddedDataSystems.com

### FEATURES

- ASCII command support for all 1-Wire devices.
- RS232, RS485 or TTL interface options.
- Parasitically (RS232) or externally powered.
- Automatically adjusts for variable 1-Wire bus conditions.
- Automatically provides smart strong-pull-up for sensors.
- 2000 feet, 200 devices per CAT-5 twisted pair 1-Wire bus.
- Supports up to 26 1-Wire networks per host serial port.
- User selectable Baud rates from 1200 to 115K Baud.
- User selectable address (1 of 26).
- User selectable error-check mode.
- RS232 version supports Broadcast Radio and Modem applications.
- Built-in DB9 for RS232/RS485/TTL interface.
- Optional RJ11 or screw-down 1-Wire bus interface connector options.
- Provides Search, Conditional Search and Family Search commands.
- Supports Touch Memory File Structure for iButtons.
- Automatically generates and checks CRC16 for TMEX files.
- Block mode commands support all 1-Wire device functions.
- ESD Protection more than 27kV (IEC801-2 Reference Model.) on the 1-Wire bus.
- Optional enclosure.

### DESCRIPTION

HA5 OPTIONS





1-wire master: HA5

Sensors(slaves):

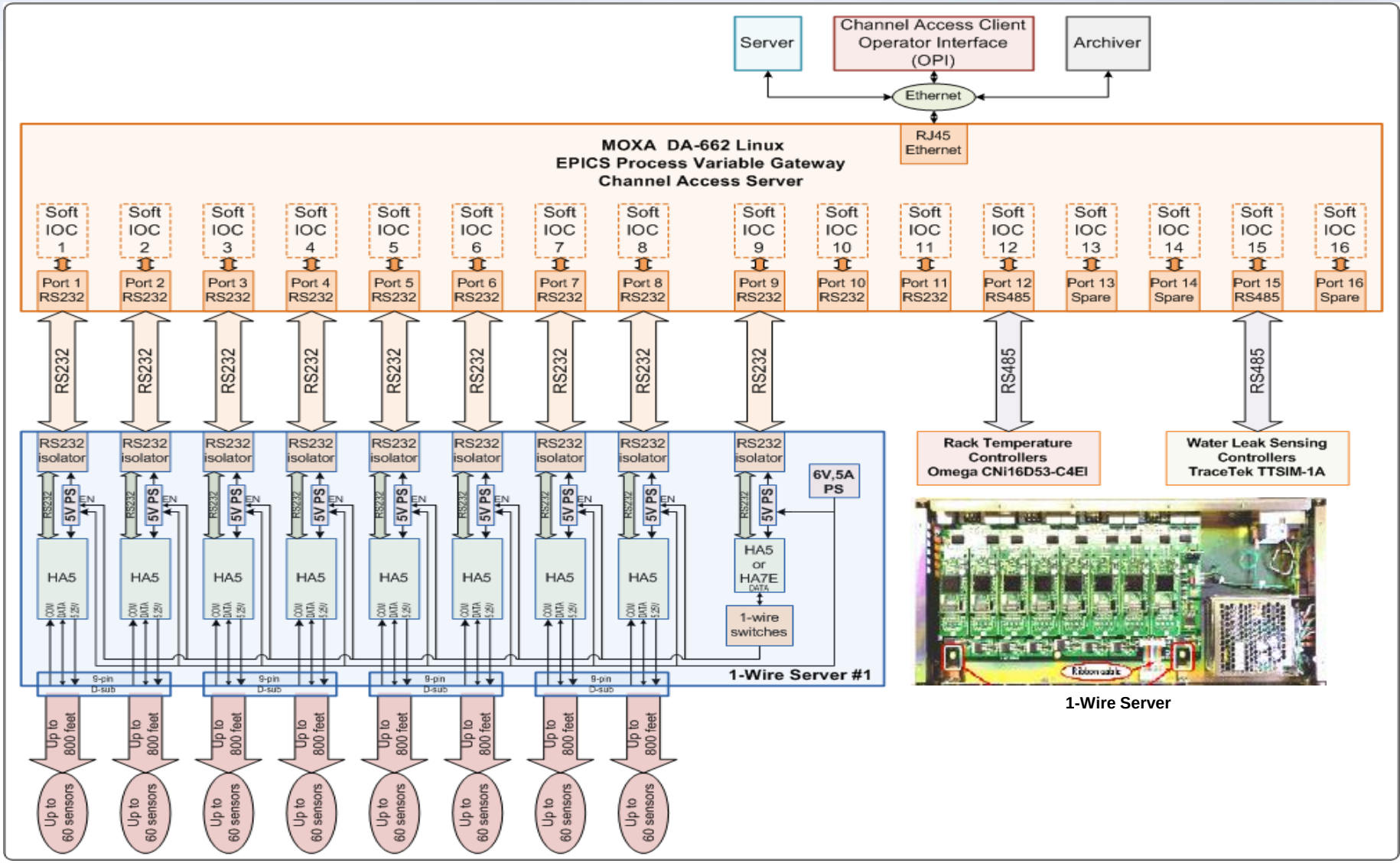
Temperature sensor: **DS18B20**

Monitors Humidity**: Honeywell HIH 400** and **DS2438**

Monitors power supply 3Φ AC input current **DS2450**

Resets chip: **DS2406**

# NSLS-II 1-Wire System: 1st Generation






1-Wire Server

# 1-Wire System

Benefits or advantages:

- Low cost: $2/sensor
- Multiple slaves are accessed using only 2-wires in this interface type.
- The data rate of 16.3 Kbps(in standard mode) and 163 kbps (in overdrive mode).
- The interface: low power, low cost, easy to implement.
- The interface supports longer distance (about 300 meters).

Disadvantages:

- Though the interface supports longer distance, it is limited due to noise and cable capacitance.
- It supports slower speed of communication.
- 1-wire slave devices are manufactured by Dallas Semiconductor (Maxim Integrated) only.

# NSLS-II 1-Wire System (1st Generation): softioc

## StreamDevice EPICS Support - OneWire Protocol

```
#System variables
Terminator = CR;
LockTimeout = 3000;
WriteTimeout = 2000;
ReadTimeout = 2000;
ReplyTimeout = 2000;

reset {
    out "aR%0<sum8>";
    in "%s";
    @init {out "aR%0<sum8>";in "%s";}
}

read_ids {
    InTerminator = "\r\r";
    out "aS,FF6C\x0d";
    in "%341c";
    @init {out "aS,FF\x0d";in "%s";}
}

###select the temperature one-wire sensor
sel_id {
    out "aA%(\$1)s%0<sum8>";
    in "%19c";
   }

read_temp {
    out "aA%(\$1)s%0<sum8>";
    in "%*s";
    out "aJ0144%0<sum8>";
    in "%*s";
    wait 100;
    out "aJ0ABEFFFFFFFFFFFFFFFF%0<sum8>";
    in "%s";
   }
```

# NSLS-II 1-Wire System (1st Generation): softioc

Stream read block data → aSub process → write to PVs

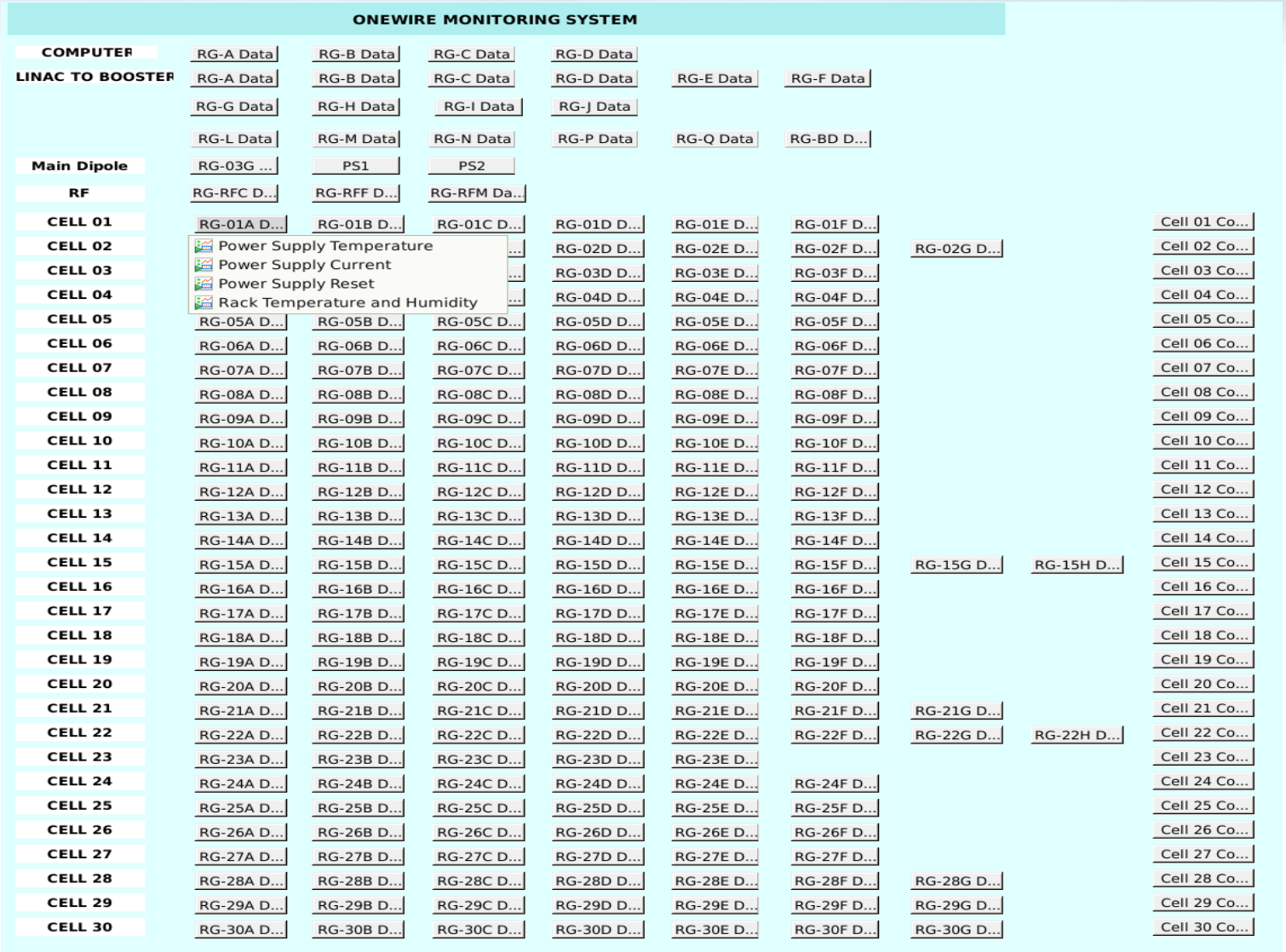
```
record (waveform, "$(Pri,undefined)$(Sec,undefined)1{PS:FXYL2A-ASM:ACPA}T:Raw_$(Chain,undefined)-Cmd")
{
    field (SCAN, "Passive")
    field (DTYP, "stream")
    field (INP,  "@Temp.proto read_temp($(Pri,undefined)$(Sec,undefined)1{PS:FXYL2A-ASM:ACPA}ID:$(Chain,undefined).VAL) $(Port,undefined)")
    field (FTVL, "UCHAR")
    field (NELM, "23")
#    field (TPRO, "1")
    field (FLNK, "$(Pri,undefined)$(Sec,undefined)1{PS:FXYL2A-ASM:2PSI}T:Raw_$(Chain,undefined)-Cmd")
}

###calculate the temperature from the raw data inside aSub; detect CRC error, etc;

record(aSub,"$(Pri,undefined)$(Sec,undefined)1{PS:FXYL2A-ASM:ACPA}T:$(Chain,undefined)-ASub")
{
    field (INAM,"tempaSubInit")
    field (SNAM,"tempaSubProcess")
    field (INPA, "$(Pri,undefined)$(Sec,undefined)1{PS:FXYL2A-ASM:ACPA}T:Raw_$(Chain,undefined)-Cmd CP")
    field (FTA, "UCHAR")
    field (NOA, "23")
    field (OUTA, "$(Pri,undefined)$(Sec,undefined)1{PS:FXYL2A-ASM:ACPA}T:$(Chain,undefined)-I")
    field (FTVA, "DOUBLE")
    field (NOVA, "1")
#   field (TPRO, "1")
}

record (ai, "$(Pri,undefined)$(Sec,undefined)1{PS:FXYL2A-ASM:ACPA}T:$(Chain,undefined)-I")
{
   field (INP,"$(Pri,undefined)$(Sec,undefined)1{PS:FXYL2A-ASM:ACPA}T:$(Chain,undefined)-ASub.VALA CP")
   field (PREC,"2")
        field (EGU, "C")
    field (LOW, "")
    field (LSV, "MINOR")
    field (HIGH, "")
    field (HSV, "MAJOR")
    field (HYST, "1")
#   field (TPRO, "1")
}
```

# 1-Wire System: CSS page of 1st Generation



# 1-Wire System: Power Supplies Temperature

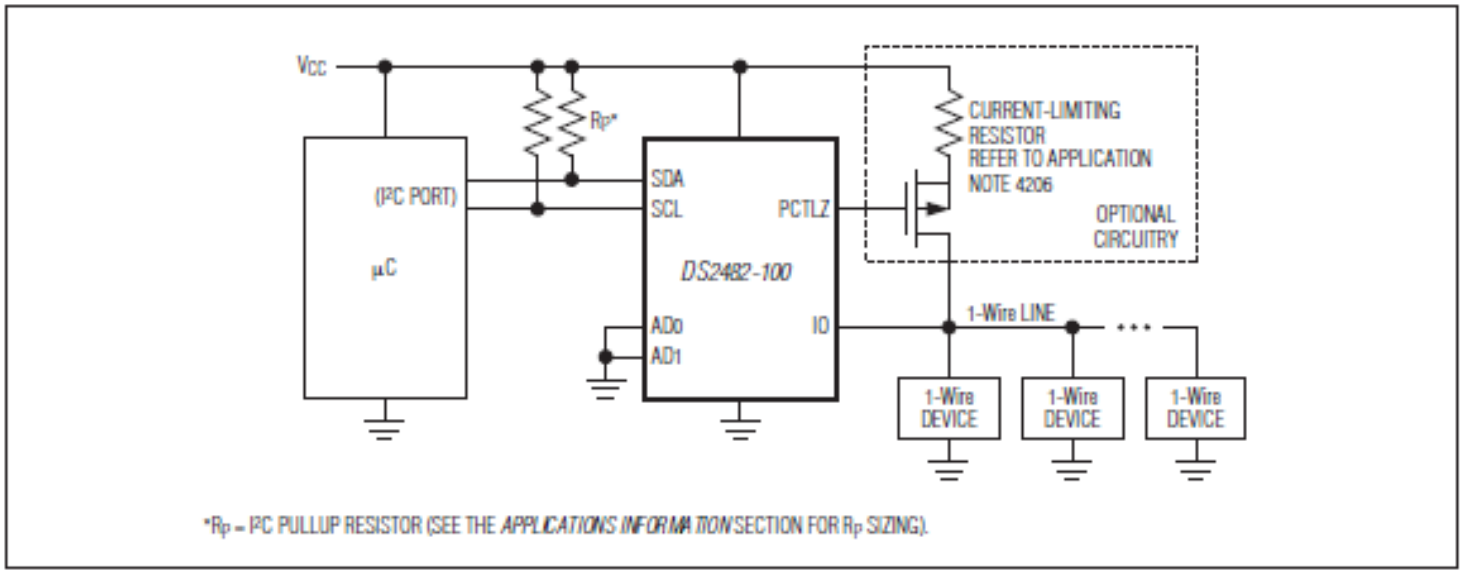
**CELL_01 - RACK A Power Supply Temperature Sensors**

| LOCATION | CHAIN 1 | | CHAIN 2 | | STATUS | ALARM LIMITS | |
|---|---|---|---|---|---|---|---|
| | SENSOR ID | TEMP | SENSOR ID | TEMP | \|CH1 - | HIGH | LOW |
| RG-A Rack 1{PS:FXYL2A-ASM:ACPA} | 5900000334FB272 | 21.12 C | 7600000335124A2 | 21.31 C | | 30 | 10 |
| RG-A Rack 1{PS:FXYL2A-ASM:2PSI} | 6F000002F757EF28 | 23.06 C | 06000002F72A7C2 | 23.06 C | | 30 | 10 |
| RG-A Rack 1{PS:FXYL2A-ASM:2RC} | 79000000DF10A42 | 23.00 C | 920000009B77552 | 22.75 C | | 30 | 10 |
| RG-A Rack 1{PS:QL2A-ASM:ACICM} | 56000002B560352 | 28.12 C | 6E000002B561D12 | 28.12 C | | 30 | 10 |
| RG-A Rack 1{PS:QL2A-ASM:SGA} | 8F0000033668422 | 31.38 C | 7A0000033655912 | 31.38 C | | 30 | 10 |
| RG-A Rack 1{PS:QL2A-ASM:1PSI} | BD000002F68BD52 | 22.19 C | 0D000002F680232 | 22.12 C | | 30 | 10 |
| RG-A Rack 1{PS:QL2A-ASM:1RC} | 2F0000009BC3652 | 23.06 C | 95000000DF2A692 | 23.06 C | | 30 | 10 |
| RG-A Rack 1{PS:QL1A-ASM:ACICM} | AD000002B5A0922 | 32.00 C | 6A000002B5A1CD2 | 32.19 C | | 30 | 10 |
| RG-A Rack 1{PS:QL1A-ASM:DLM} | EA0000038782B02 | 31.00 C | 20000003878FAC2 | 30.94 C | | 30 | 10 |
| RG-A Rack 1{PS:QL1A-ASM:1PSI} | 97000002F688882 | 24.12 C | A3000002F661FF2 | 24.19 C | | 30 | 10 |
| RG-A Rack 1{PS:QL1A-ASM:1RC} | 660000009B658F2 | 24.00 C | F10000009B87002 | 24.06 C | | 30 | 10 |
| RG-A Rack 1{PS:CXYL1A-ASM:ACICM} | 4A000002B593542 | 28.75 C | 8F000002B587EC2 | 28.75 C | | 30 | 10 |
| RG-A Rack 1{PS:CYL1A-ASM:XG-CH2} | 310000009B80B92 | 27.50 C | 710000009B6E442 | 27.62 C | | 30 | 10 |
| RG-A Rack 1{PS:CXL1A-ASM:XG-CH1} | AD0000033525332 | 28.94 C | 250000033520A62 | 28.75 C | | 30 | 10 |
| RG-A Rack 1{PS:CYL1A-ASM:PA-CH2} | C50000033509A32 | 22.31 C | 9E0000033510EB2 | 22.31 C | | 30 | 10 |
| RG-A Rack 1{PS:CXL1A-ASM:PA-CH1} | 0000000334F4A32 | 23.56 C | 1C0000033500D52 | 23.56 C | | 30 | 10 |
| RG-A Rack 1{PS:CXYL1A-ASM:2PSI} | 18000002B59D132 | 29.19 C | 9E000002F75A982 | 29.06 C | | 30 | 10 |
| RG-A Rack 1{PS:CXYL1A-ASM:2RC} | D9000002F68FEC2 | 29.56 C | 9A000002F6485D2 | 29.62 C | | 30 | 10 |

# NSLS-II 1-Wire System: 2nd Generation

The **DS2483** is an I²C-to-1-Wire bridge device that interfaces directly to standard (100kHz max) or fast (400kHz max) I²C masters to perform protocol conversion between the I²C master and any downstream 1-Wire slave devices.

## Typical Operating Circuit

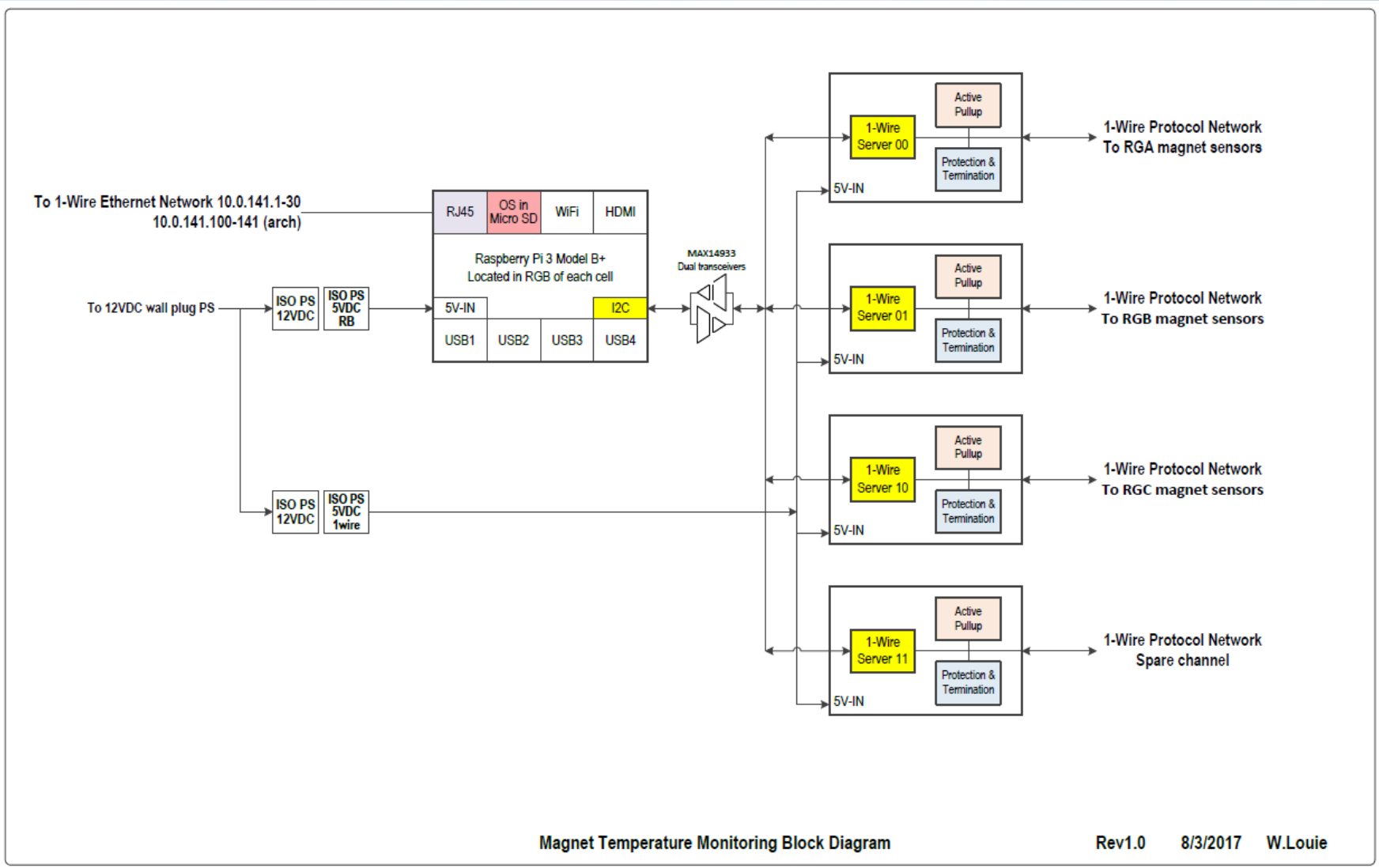



*1-Wire is a registered trademark of Maxim Integrated Products, Inc.*

maxim integrated™

*19-4930; Rev 10; 1/15*

# NSLS-II 1-Wire System: 2nd Generation



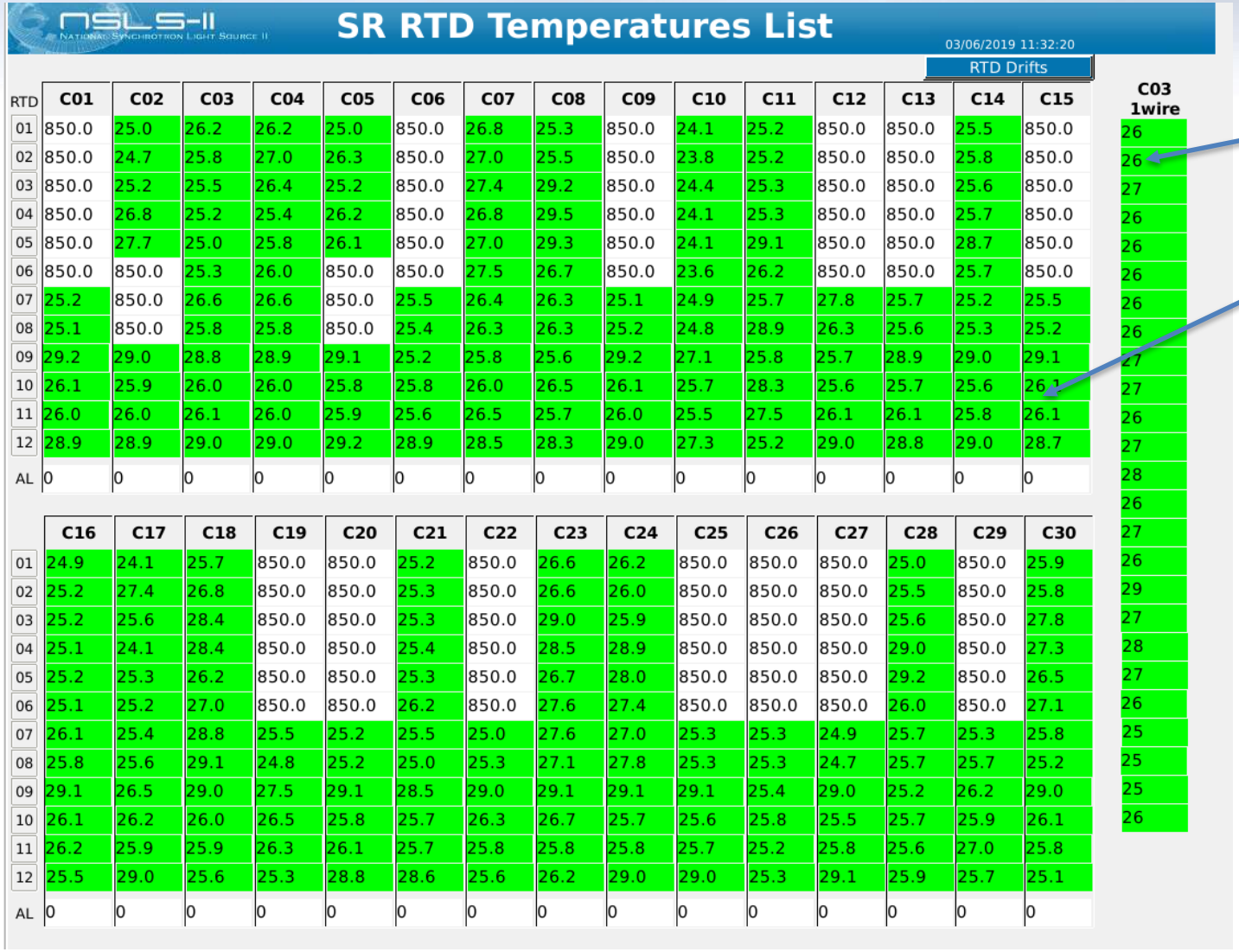
# NSLS-II 1-Wire System (2nd Generation): softioc

Python socket programing to get block data → parse data → write to PVs

```
except:
    print 'Sent getTempData failed, close socket and exit.'
    s.close()
    raise
print 'Magic word sent.'
print 'Waiting for data from the server.'
print 'Be patient, wait time can be as much as 60 seconds.'
# Try to receive all temp data.
# The first number is the total of characters of the entire message.
# The second number is import rethe number of sensors, follow by a comma.
# Magnet name (space) IDimport cothread
# The last number is the length of string, not counting the length number.
try:
    data = s.recv(1460)
    charNum = 1
    bufloop = 0
    while str(charNum) != ',':
        charNum = int(bufloop+1)
        charNum = str(data[(int(charNum)-1):(int(charNum))])
        bufloop = bufloop+1
        #print 'charNump=',charNum, 'bufloop=',bufloop
    # Empty all the data. Each frame = 1460 bytes.
    charNum = int(int(data[:bufloop-1])/1460)
    print 'Total number of bytes is '+str(data[:bufloop-1])+'.'
    print 'Total number of frames is '+str(charNum+1)+'.'
    for dataframe in range (charNum):
        dataTemp = s.recv(1460)
        data = data + dataTemp
    print data


    # For EPICS to do something with all the received data here.
    print '---- EPICS program starts here on converting received data to PVs. ----'
    sl=re.split(" |,",data)
    for i in range (1,26):
        loc='SR:C03-VA{1wire:'+"%02d"%i+'}T-I.DESC'
        location=caget(loc)
        index=sl.index(location)
        print index
        pv='SR:C03-VA{1wire:'+"%02d"%i+'}T-I'
        caput(pv,sl[index+2])
except:
    #print 'Failure on receiving all',str(numRead),'data. Close socket and exit.'
    print 'Failure on receiving all the data. Close socket and exit.'
    s.close()
    raise
# calculate for wait time to the next scan.
TimeDone = time.time()
TimeWait = ((TimeStart + loopTime) - TimeDone)
if TimeWait <= 0.0:
    TimeWait = 0.0
```

# 1-Wire System (2nd Generation): CSS OPI



NSLS-II National Synchrotron Light Source II

## SR RTD Temperatures List

03/06/2019 11:32:20

RTD Drifts

| RTD | C01 | C02 | C03 | C04 | C05 | C06 | C07 | C08 | C09 | C10 | C11 | C12 | C13 | C14 | C15 | C03 1wire |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 850.0 | 25.0 | 26.2 | 26.2 | 25.0 | 850.0 | 26.8 | 25.3 | 850.0 | 24.1 | 25.2 | 850.0 | 850.0 | 25.5 | 850.0 | 26 |
| 02 | 850.0 | 24.7 | 25.8 | 27.0 | 26.3 | 850.0 | 27.0 | 25.5 | 850.0 | 23.8 | 25.2 | 850.0 | 850.0 | 25.8 | 850.0 | 26 |
| 03 | 850.0 | 25.2 | 25.5 | 26.4 | 25.2 | 850.0 | 27.4 | 29.2 | 850.0 | 24.4 | 25.3 | 850.0 | 850.0 | 25.6 | 850.0 | 27 |
| 04 | 850.0 | 26.8 | 25.2 | 25.4 | 26.2 | 850.0 | 26.8 | 29.5 | 850.0 | 24.1 | 25.3 | 850.0 | 850.0 | 25.7 | 850.0 | 26 |
| 05 | 850.0 | 27.7 | 25.0 | 25.8 | 26.1 | 850.0 | 27.0 | 29.3 | 850.0 | 24.1 | 29.1 | 850.0 | 850.0 | 28.7 | 850.0 | 26 |
| 06 | 850.0 | 850.0 | 25.3 | 26.0 | 850.0 | 850.0 | 27.5 | 26.7 | 850.0 | 23.6 | 26.2 | 850.0 | 850.0 | 25.7 | 850.0 | 26 |
| 07 | 25.2 | 850.0 | 26.6 | 26.6 | 850.0 | 25.5 | 26.4 | 26.3 | 25.1 | 24.9 | 25.7 | 27.8 | 25.7 | 25.2 | 25.5 | 26 |
| 08 | 25.1 | 850.0 | 25.8 | 25.8 | 850.0 | 25.4 | 26.3 | 26.3 | 25.2 | 24.8 | 28.9 | 26.3 | 25.6 | 25.3 | 25.2 | 26 |
| 09 | 29.2 | 29.0 | 28.8 | 28.9 | 29.1 | 25.2 | 25.8 | 25.6 | 29.2 | 27.1 | 25.8 | 25.7 | 28.9 | 29.0 | 29.1 | 27 |
| 10 | 26.1 | 25.9 | 26.0 | 26.0 | 25.8 | 25.8 | 26.0 | 26.5 | 26.1 | 25.7 | 28.3 | 25.6 | 25.7 | 25.6 | 26.1 | 27 |
| 11 | 26.0 | 26.0 | 26.1 | 26.0 | 25.9 | 25.6 | 26.5 | 25.7 | 26.0 | 25.5 | 27.5 | 26.1 | 26.1 | 25.8 | 26.1 | 26 |
| 12 | 28.9 | 28.9 | 29.0 | 29.0 | 29.2 | 28.9 | 28.5 | 28.3 | 29.0 | 27.3 | 25.2 | 29.0 | 28.8 | 29.0 | 28.7 | 27 |
| AL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |

| | C16 | C17 | C18 | C19 | C20 | C21 | C22 | C23 | C24 | C25 | C26 | C27 | C28 | C29 | C30 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 24.9 | 24.1 | 25.7 | 850.0 | 850.0 | 25.2 | 850.0 | 26.6 | 26.2 | 850.0 | 850.0 | 850.0 | 25.0 | 850.0 | 25.9 | 26 |
| 02 | 25.2 | 27.4 | 26.8 | 850.0 | 850.0 | 25.3 | 850.0 | 26.6 | 26.0 | 850.0 | 850.0 | 850.0 | 25.5 | 850.0 | 25.8 | 29 |
| 03 | 25.2 | 25.6 | 28.4 | 850.0 | 850.0 | 25.3 | 850.0 | 29.0 | 25.9 | 850.0 | 850.0 | 850.0 | 25.6 | 850.0 | 27.8 | 27 |
| 04 | 25.1 | 24.1 | 28.4 | 850.0 | 850.0 | 25.4 | 850.0 | 28.5 | 28.9 | 850.0 | 850.0 | 850.0 | 29.0 | 850.0 | 27.3 | 28 |
| 05 | 25.2 | 25.3 | 26.2 | 850.0 | 850.0 | 25.3 | 850.0 | 26.7 | 28.0 | 850.0 | 850.0 | 850.0 | 29.2 | 850.0 | 26.5 | 27 |
| 06 | 25.1 | 25.2 | 27.0 | 850.0 | 850.0 | 26.2 | 850.0 | 27.6 | 27.4 | 850.0 | 850.0 | 850.0 | 26.0 | 850.0 | 27.1 | 26 |
| 07 | 26.1 | 25.4 | 28.8 | 25.5 | 25.2 | 25.5 | 25.0 | 27.6 | 27.0 | 25.3 | 25.3 | 24.9 | 25.7 | 25.3 | 25.8 | 25 |
| 08 | 25.8 | 25.6 | 29.1 | 24.8 | 25.2 | 25.0 | 25.3 | 27.1 | 27.8 | 25.3 | 25.3 | 24.7 | 25.7 | 25.7 | 25.2 | 25 |
| 09 | 29.1 | 26.5 | 29.0 | 27.5 | 29.1 | 28.5 | 29.0 | 29.1 | 29.1 | 29.1 | 25.4 | 29.0 | 25.2 | 26.2 | 29.0 | 25 |
| 10 | 26.1 | 26.2 | 26.0 | 26.5 | 25.8 | 25.7 | 26.3 | 26.7 | 25.7 | 25.6 | 25.8 | 25.5 | 25.7 | 25.9 | 26.1 | 26 |
| 11 | 26.2 | 25.9 | 25.9 | 26.3 | 26.1 | 25.7 | 25.8 | 25.8 | 25.8 | 25.7 | 25.2 | 25.8 | 25.6 | 27.0 | 25.8 | |
| 12 | 25.5 | 29.0 | 25.6 | 25.3 | 28.8 | 28.6 | 25.6 | 26.2 | 29.0 | 29.0 | 25.3 | 29.1 | 25.9 | 25.7 | 25.1 | |
| AL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

1-WireC

RTD + PLC

# THANK YOU