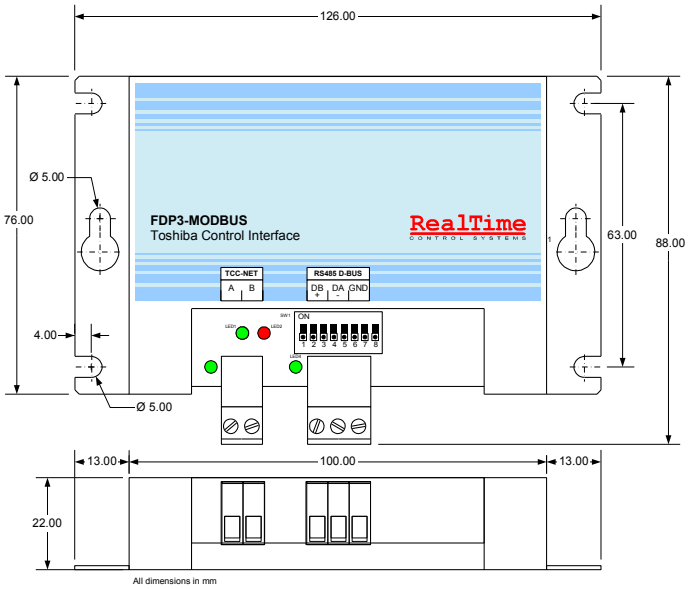
FDP3-Modbus Interface v1.05

Installation and Operating Instructions



FDP3-Modbus Description

The FDP3-Modbus is a low cost Modbus based monitoring and control interface for Toshiba VRF and Split ranges of air-conditioners. The interface is compatible with all units that have a TCC-NET A,B remote controller network connection. No other network adaptor cards are required even for split A/C units.

Functions

UNIT CONTROL. Control of Setpoint, Fanspeed, Runmode, Louvre mode and on/off state through Modbus registers.

REMOTE CONTROLLER Facility to individually lock and unlock each remote controller button associated with unit control.

FAULT CODES. Readback of all indoor and outdoor unit fault codes

UNIT TEMPERATURES Indoor unit air and coil temperatures is available

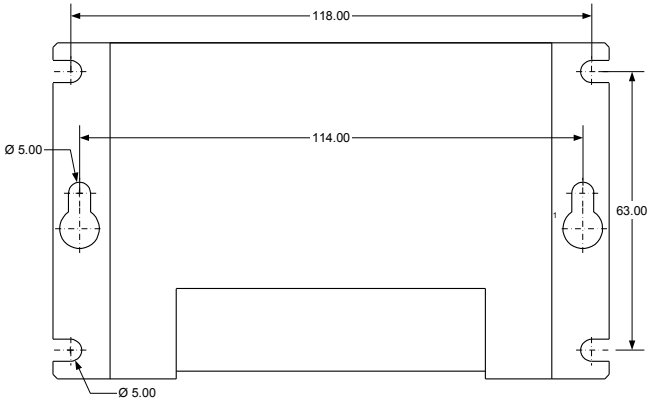
RS485 NETWORK Multiple FDP3-Modbus interfaces can be networked on an RS485 network to provide control of multi zone systems.

Warnings and Cautions

Do not exceed the specified fault relay ratings

Observe precautions for handling Electrostatic Sensitive Devices

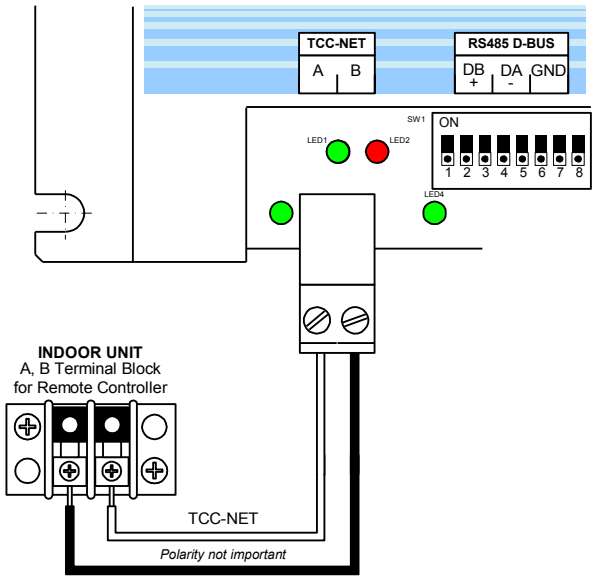
Mounting



The FDP3-Modbus can be mounted horizontally or vertically.

TCC-NET Network

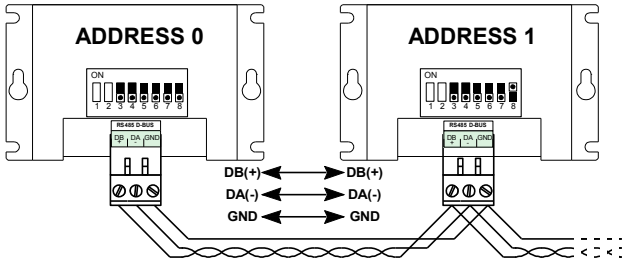
TCC-NET Terminals A, B connect to the Toshiba TCC-NET remote controller network. The FDP3 is powered from this connection and communicates with the indoor unit on this network. The FDP3 can be connected together with one Toshiba remote controller.



Networking

NETWORK INSTALLATION

The RS485 D-Bus network requires a twisted pair cable connecting terminals DB(+) and DA(-) on each FDP3 as shown below. Terminal DB must be connected to all other DB terminals. Terminal DA must be connected to all other DA terminals. In addition the common terminal GND on all devices must be connected together. If a shielded cable is used then the shield can be used for this purpose. The network must be installed as a daisy-chained point-to-point Bus configuration, Star and Ring connections must NOT be used.



SPECIFICATION

Use stranded 24awg shielded or unshielded twisted pair to Cat3, Cat4 or Cat5 specification. Use a twisted pair for connections DB,DA and an extra core for connection GND.

NETWORK LENGTH

Standard installation for total network distances of up to 500m can be achieved following the basic daisy-chaining method showed in the above diagram. Network termination should not be necessary for networks of this length. The network can be extended further using RS485 repeaters.

NETWORK DEVICE COUNT

Each FDP3 has half a standard RS485 network load. An RS485 network can have a maximum of 32 standard network loads. Assuming the Modbus master is a standard network load then a maximum of 62 FDP3 devices can be placed on a single physical network.

ADDRESSING

Each FDP3-Modbus must have a unique Modbus network address in the range 0 to 63 using DIP switches SW1.3 to SW1.8. A table of switch setting is given on the last page of this datasheet.

Modbus Protocol

MODBUS CONFIGURATION

Network 3 wire RS485
Mode Modbus RTU Slave
Baud 9600
Parity None
Stop bits 1
Register Base 0

Note: FDP3 interfaces can be configured with different baud rate and parity settings if required

MODBUS REGISTERS

The FDP3-Modbus supports two types of register, analogue *Holding Registers* and analogue *Input Registers*. Register Addresses are '0' based in the range 0..65535.

Register Type	Access	Function
Holding Register	Read/Write	Control and Command Registers
Input Register	Read Only	Readback and Monitoring Registers

All analogue and digital values are accessed through these registers. All register values are 2 byte (16 bit) values.

Different data types are returned using specific conventions

Data Type	Range	Convention
Digital	0..1	0=FALSE, 1=TRUE
Integer	0..65535	No scaling required
Temperature	0..65535	Temperatures values are generally returned *multiplied by 100* to allow greater precision. To allow for negative temperature the value is returned as a *signed integer*, this means that any value greater than 32767 must be converted into a negative value by subtracting 65536. **Examples:** A readback value of 2150 is a positive temperature so: 2150 / 100 = 21.50°C A readback value of 65036 is a negative temperature so: 65036 – 65536 = -500 -500 / 100 = -5.00°C

Registers are accessed using standard Modbus functions. The following four functions are supported by the FDP3 interface.

Function Code (hex code)	Function Name	Register Count
03 (03h)	Read Holding Registers	1..10
04 (04h)	Read Input Registers	1..10
06 (06h)	Preset Single Holding Register	1
16 (10h)	Preset Multiple Holding Register	1..10

In this document, Holding registers are written as **H0010** where '**H**' indicates *Holding* register and '**0010**' indicates the register address 0010. Similarly Input registers are referred to as **I0010** where '**I**' indicates an *Input* register.

Control Functions

CONTROL

The FDP3-Modbus can be used to control all of the operating functions of the air-conditioning system that are available from a standard remote controller. All control registers are analogue Holding Registers**.**

Holding Register	Name	Range
H0001	Setpoint	10..40
H0002	Fanspeed	0..3 (0:Auto, 1:Low, 2:Medium, 3: High)
H0003	Mode	0..4 (0:Auto, 1:Heat, 2:Fan, 3:Cool, 4:Dry)
H0004	Louvre	1..7 (1:Swing, 2: 0 Degrees, 3: 20 Degrees, 4:45 Degreees, 5:70 Degrees, 6:90 Degrees)
H0005	OnOff	0..1 (0:Off, 1:On)

CONTROL UPDATE MODE

Each control field has a corresponding Update Register which determines how the control commands update the unit and if the corresponding remote controller button(s) are locked or unlocked. Four update modes are available:

Update Mode	Keypad Button(s)	Functionality
0:LastTouch	Unlocked	Unit setting is updated when a holding register WRITE occurs even if the value is unchanged.
1:Central	Locked	The corresponding keypad buttons are locked. The value in the holding register is repeatedly written to the unit.
2:Local	Unlocked	Updates to holding registers are not sent to the unit.
3:OnChange	Unlocked	Unit setting is updated when a holding register WRITE occurs only if the value CHANGES.

The *Last Touched* update mode allows updates from the Keypad or Modbus registers. This requires that WRITES to the Modbus holding register only occur when a change is made. If the Modbus master repeatedly writes the value then this will overwrite the user setting. The *On Change* update mode can be used if repeated writes occur, in which case updates are only sent to the AC unit if the written value changes.

The *Global Update* register **H0010** can be used to set all update registers with one command, or the individual registers can be written to.

Holding Register	Name	Lock Mode*
H0010	Global Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0011	Setpoint Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0012	Fanspeed Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0013	Mode Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0014	Louvre Update	**0:LastTouch**,1:Central,2:Local,3:OnChange
H0015	OnOff Update	**0:LastTouch**,1:Central,2:Local,3:OnChange

***Last Touch** updates are written to the A/C on every register write. **On Change** updates are only sent if the value written changes. **Central** locks the corresponding RC button. **Local** unlocks the RC button and prevents any updates from the FDP3.

The default settings on power up are all fields in Last Touch mode.

CONTROL LIMITING

The Control Limit registers allow adjustment from the remote controller or central controller to be limited to specified ranges. The setpoint can be optionally limited to minimum and maximum specified values. Fanspeed, Mode and Louvre settings can also be limited to specific settings using an inhibit value. If the limit values are set to 0 then no limit is applied.

Holding Register	Name	Range
H0020	Setpoint Min	18..31, **0 = No Limit**
H0021	Setpoint Max	18..31, **0 = No Limit**
H0022	Fanspeed Inhibit	**0 = No Inhibit**, else Inhibit Value
H0023	Mode Inhibit	**0 = No Inhibit**, else Inhibit Value
H0024	Louvre Inhibit	**0 = No Inhibit**, else Inhibit Value

Fanspeed, Mode and Louvre inhibit values are calculated by adding the inhibit values for each setting to be inhibited. The values are as follows

Fan Inhibit

Fanspeed	Inhibit Value
Auto	**1**
Low	**2**
Medium	**4**
High	**8**

Mode Inhibit

Run Mode	Inhibit Value
AUTO	**1**
HEAT	**2**
FAN	**4**
COOL	**8**
DRY	**16**

Louvre Inhibit

Louvre Position	Inhibit Value
Swing	**2**
0 Degrees	**4**
20 Degrees	**8**
45 Degrees	**16**
70 Degrees	**32**
90 Degrees	**64**

Examples:

To limit the Mode setting to Heat, Cool and Fan:

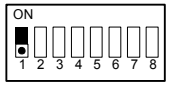
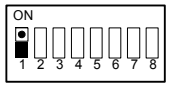
Mode Inhibit Value = AUTO + FAN + DRY
= (1 + 4 + 16)
= 21

To limit the Louvre setting 0 Degree, 20 Degrees, 45 Degrees:

Louvre Inhibit Value = Swing + 70 Degrees + 90 Degrees

MODBUS MASTER TIMEOUT

The FDP3-Modbus can be configured to operate with an optional Modbus Master timeout. In this configuration if no Holding Register writes occur for a period of 120 seconds then a timeout event will occur and all A/C units will be switched on with their current settings. In a timeout condition the FDP3 Leds will indicate an *RS485 Communications Timeout* as illustrated in the *LED Functionality* section of this datasheet. FDP3 DIP Switch settings to enable or disable Modbus Master Timeout are shown in the following table.

Switch Setting	Function
	No Timeout
	Timeout if no Holding Register WRITE command for 120 seconds. All units switched ON with current settings. Remote controllers UNLOCKED.

Readback Data

All readback data is available in analogue Input Registers.

GROUP READBACK

Group data registers provide a summary of the data from all active indoor units on the network.

Input Register	Name	Range	Notes
I0020	Unit Count	0..16	Number of units found on network
I0021	Is Fault	0..1	0:No Fault, 1: At least one unit in fault
I0022	Fault Code	0..65535	255: No Fault, else fault code from first unit in fault
I0023	Return Air Average	Degrees C x 100	Average of all unit return air temperatures
I0024	Filter Alarm	0..1	0: No Alarm, 1: At least one unit with filter alarm
I0025	Return Air Min	Degrees C x 100	Minimum of all unit return air temperatures
I0026	Return Air Max	Degrees C x 100	Maximum of all unit return air temperatures
I0030	Thermo On	0..3	Summary of unit operation 0:Idle/Fan, 1:Heating, 2:Cooling, 3:Heat and Cool
I0035	Defrost	0..1	0: No defrost, 1: At least one unit in defrost

REMOTE CONTROLLER READBACK

Input Register	Name	Range
I0050	RC Temperature	Degrees C x 100 (only available for 1 indoor unit)
I0052	RC Exists	0: No RC, 1: RC Available

UNIT READBACK

Unit data is available for each of the indoor units on the network. Unit Input registers are numbered using the indoor unit numbering in the range 1 to 8 x 100 added to an offset relating to a specific feature.

Unit 1	Unit 2	...	Unit 8	Name	Range	Notes
0120	0220	...	0820	Unit Exists	0..1	0: No Unit Found, 1: Unit Found
0121	0221	...	0821	Is Fault	0..1	0: No Unit Fault, 1: Unit in Fault
0122	0222	...	0822	Fault Code	0..65535	255: No Fault, else fault code
0123	0223	...	0823	Return Air Temperature	Degrees C x 100	Unit Return Air Sensor Value
0124	0224	...	0824	Filter Alarm	0..1	0: No Alarm, 1: Filter Alarm
0130	0230	...	0830	Thermo On	0..2	0:Idle/Fan, 1:Heating, 2:Cooling
0131	0231	...	0831	Coil TC* Temperature	Degrees C x 100	TC Coil Temperature (*TC2 for VRF)
0132	0232	...	0832	Coil TCJ Temperature	Degrees C x 100	TCJ Coil Temperature
0134	0234	...	0834	Indoor Duty	0..15	Unit Duty 0..15 = 0..100%
0135	0235	...	0835	Defrost	0..1	0:Unit Operating, 1:Unit Defrost
0142	0242	...	0842	Line address	1..32	
0143	0243	...	0843	Unit address	1..32	

Fault Codes

FAULT CODES

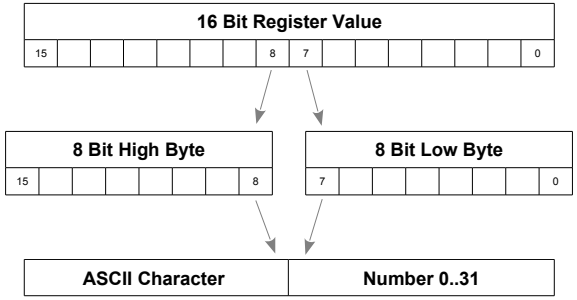
Fault codes are encoded using a standard table to allow standard Toshiba fault codes to be generated from the readback value. The **no fault** value is 255.

Special fault codes generated by the FDP3 are as follows

Code Value	Meaning
0	Waiting for data
255	No Fault
14384	(80) Group Fault, timeout on no units found
14388	(84) Unit Missing, reported if unit data previously observed

All other codes are Toshiba fault codes. The full table of fault code values is available from ***http://www.realtime-controls.co.uk/***

Fault codes returned from a Modbus Input register are 16 bit values. The fault code is encoded in the 16 bit value by encoding the two 8 bit fault fields in the high and low byte parts of the 16 bit value. The high byte represents an ASCII text character and the low byte is a decimal value in the range 0 to 31. The low byte value is written as two digits, so e.g. 9 is written as 09.



Example:

A fault code value of 17668 is returned.

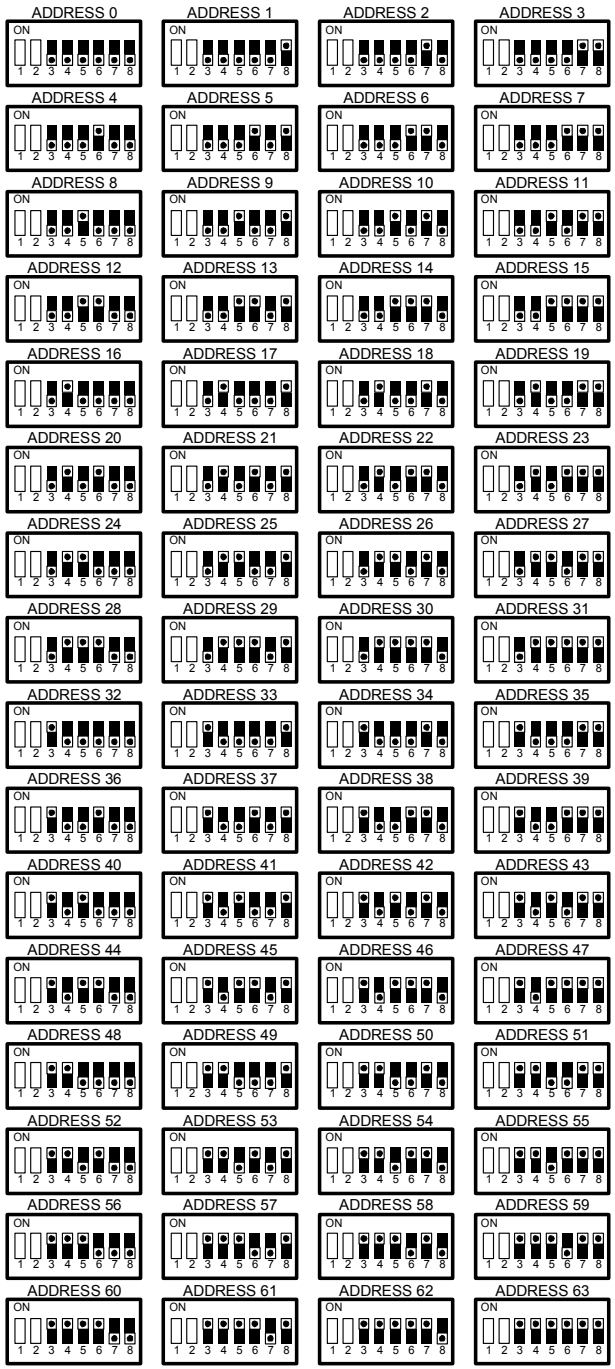
HighByte(17668) = 69 = ASCII Character 'E'

LowByte(17668) = 4 = Decimal Code 04

Fault Code: 'E04'

Modbus Addressing

The Modbus Address of the FDP3 is set with the 6 right dip switches on SW1.
The address range is 0 to 63.



LED Functionality

Key: ○ OFF ☼ FLASHING ☀ ON

Normal Operation

R ☀ ☀ ☀ ☀ ☀ ○ G ☀ ☀ ☀ ☀ ☀ ○	Power-Up sequence Factory Configuration
R ☼ ☼ ☼ ☼ ☼ ○ G ☀ ☀ ☀ ☀ ☀ ○	Power-Up sequence Custom Configuration
R ○ G ☼	TCC-NET Search. After power-up and during unit configuration

R ○ G ☀	No Fault State
R ☀ G ○	Unit Fault

Error Conditions

R ☀ ○ ☀ ○ ☀ ○