HYGROCHIP
DIGITAL HUMIDITY SENSOR PROTOCOL DESCRIPTION I2C

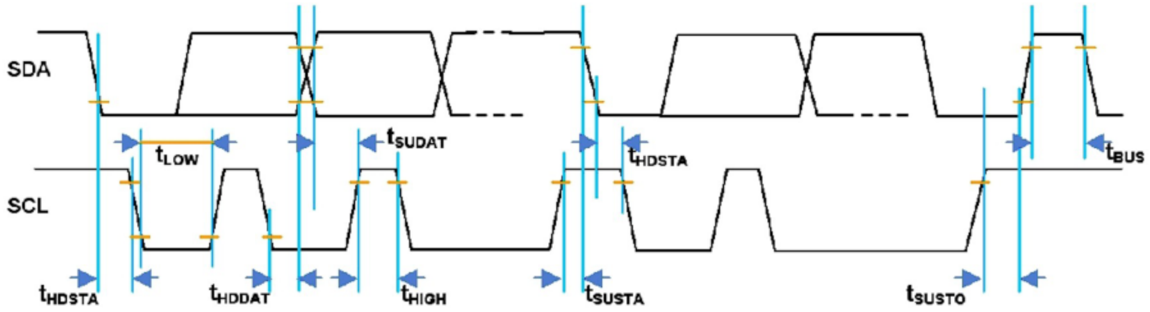


Figure – I²C Timing Diagram

I²C Interface and Timing

For integration with a micro-controller, the humidity module has an I²C-compatible interface which supports both 100kHz and 400kHz bit rates. The I²C slave address is programmed by default on 0x28 and can be adjusted in the entire address range (0x00 to 0x7F). Hence, up to 126 humidity modules can be operated on a single I²C-Bus.

PARAMETER	SYMBOL	MIN	MAX	UNIT
SCL clock frequency	fSCL	100	400	kHz
Start condition hold time relative to SCL edge	tHDSTA	0.1		µs
Minimum SCL clock low width 1	tLOW	0.6		µs
Minimum SCL clock high width 1	tHIGH	0.6		µs
Start condition setup time relative to SCL edge	tSUSTA	0.1		µs
Data hold time on SDA relative to SCL edge	tHDDAT	0		µs
Data setup time on SDA relative to SCL edge	tSUDAT	0.1		µs
Stop condition setup time on SCL	tSUSTO	0.1		µs
Bus free time between stop condition and start condition	tBUS	1		µs

There are two I²C commands for the user to access the humidity module:

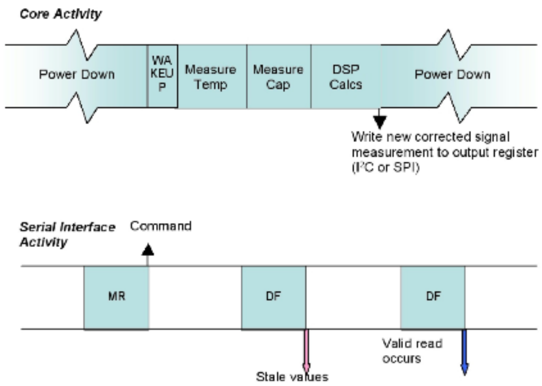
Command	Description
'Data Fetch' (DF)	Fetch the last measured value of Humidity / Temperature
'Measuring Request' (MR)	Start a measuring cycle

In the initial condition, the humidity module is in sleep mode to minimize the current consumption. A new measurement is carried out only after the command measuring request (MR) is received.

Access to the status bits and measured values is made by the data fetch command.

After the measuring cycle has been completely processed, the ready status bit is set and the current measured values are available. To determine if the measuring cycle has been already finished, the output registers may be cyclically polled.

If the access to the measured values takes place too early, the measured values of the previous measuring cycle are transferred and the stale status bit is set.



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MR (Measurement Requests)

By a measurement request command, the sleep mode is terminated and the humidity module executes a measurement cycle. The measuring cycle begins with the temperature measurement, followed by humidity measurement, digital signal processing (linearizing, temperature compensation) and finally writes the processed measured values into the output register.

The MR command consists of the address of the humidity module, with which the R/W bit is transferred as 0 (= write). After the humidity module is answered with ACK (= measurement started), the master finalized the transfer with NACK (ACK= 1) and launches stop condition.

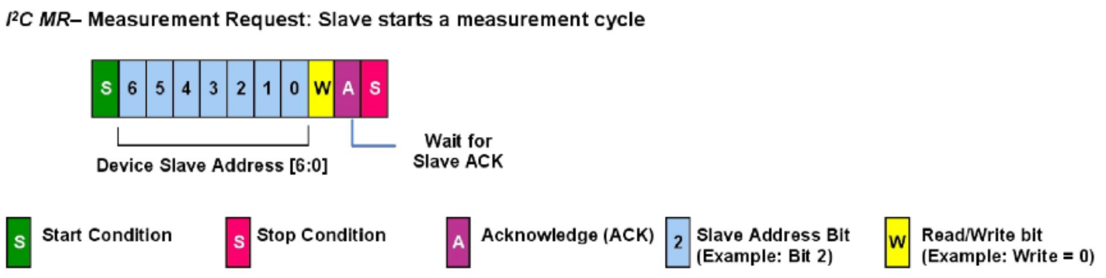

Figure – I²C MR

DF (Data Fetch)

The data fetch command serves to finish reading the output register. The DF command is sent by the master to the humidity module (slave) and begins with the 7 Bit slave address. The 8th bit is 1 (= read). The Humidity module sends back an acknowledgement (ACK =0) in case of correct addressing.

The number of bits, that the humidity module sends back, is completed when the master sends a NACK (ACK= 1) and launches stop condition. The first two bytes of measurement data contain the two status bits as MSB, followed by the humidity value with 14 bits.

If temperature data is needed, these can be read after the humidity value. The most significant 8 bits of the temperature value will be transferred as third byte. Then the least significant 6 bits of the temperature value can be read as the fourth byte. The last two bits are not used and should be masked away.

The master has the possibility to terminate the reading after each read byte through a NACK. Hence, it is possible to finish reading even after the first byte and evaluate only the status/stale bit and the master can terminate the transfer without completing the whole cycle. If only the upper 8 bits of the temperature value are to be transferred (8 bit resolution), the transfer can be aborted after the third byte by a NACK.

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HUMIDITY
TEMPERATURE
FLOW
CONDUCTIVITY

HYGROCHIP
DIGITAL HUMIDITY SENSOR
PROTOCOL DESCRIPTION I2C

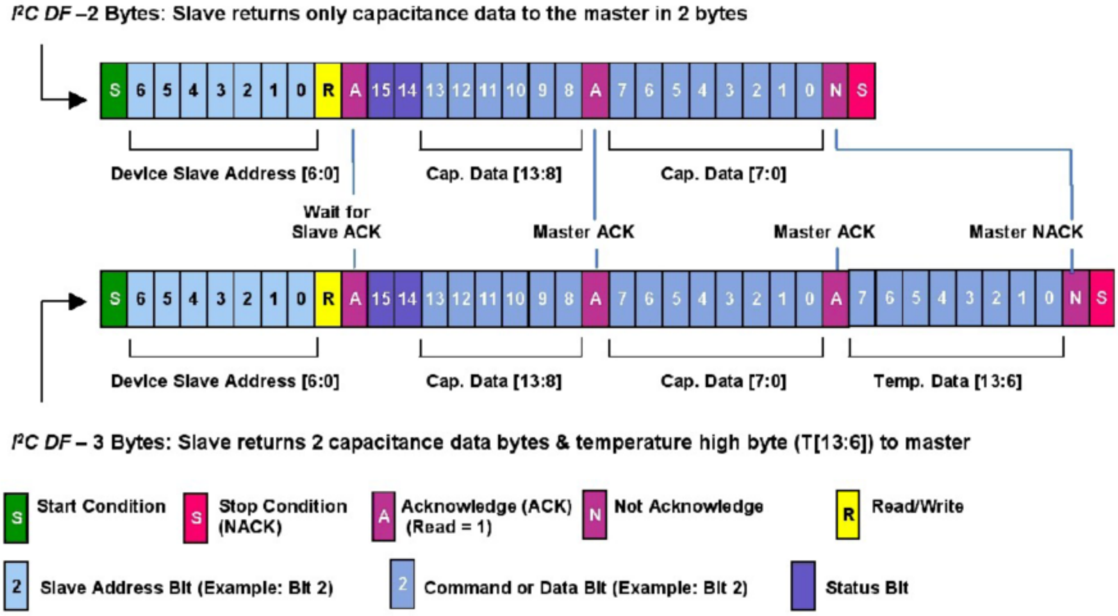

Figure – I²C Measurement Packet Reads

Scaling of measurement values

T_{raw} and rH_{raw} are the digital 16 bit values submitted by the sensor.

The first top bits are status bits with following relevance:

Bit 15: CMode Bit, if 1 – element is in command mode

Bit 14: Stale bit, if 1 – no new value has been created since the last reading.

To mask the 2 top status bits in a 16 bit value, it will be linked logically with 3FFF and AND. The remaining 14 bit represents the measured value.

The masked value data now have to be scaled into physical measurement units:

$T\,[°C] = (165 / 2^{14}) * T_{raw} - 40$

Example:

0x0 complies with -40°C

0x3FFF complies with +125°C

T_{raw} = 0x0000….0x3FFF (Hex) or 0…..16383 (Dec)

Humidity values will be calculated as follows:

$rH\,[\%] = (100 / 2^{14}) * rH_{raw}$

Example:

0x0 complies with - 0%rH

0x3FFF complies with 100%rH

rH_{raw} = 0x0000….0x3FFF(Hex) or 0…..16383 (Dec)

C-Code examples are available upon request.

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ISO 9001

HYT – Änderung der I2C-Adresse

Um die I2C-Adresse des Sensormoduls HYT auszulesen, muss das Modul in den Command-Mode umgeschaltet werden. Die Umschaltung erfolgt durch senden der Start-Command-Mode-Nachricht über I2C-Bus innerhalb von 10ms nach Power-On Reset. Jede Command-Mode-Nachricht besteht aus 4 Byte und ist in Tabelle 1 dargestellt.

S	6	5	4	3	2	1	0	W	A	7	6	5	4	3	2	1	0	A	7	6	5	4	3	2	1	0	A	7	6	5	4	3	2	1	0	A	P
S	0	1	0	1	0	0	0	0	A	C	C	C	C	C	C	C	C	A	D	D	D	D	D	D	D	D	A	D	D	D	D	D	D	D	D	A	P
	Slave Address									Command Byte									Command Data [15:8]									Command Data [7:0]									

Tabelle 1

SlaveAddress:	0x28	Basiswert
Command-Byte:	0xA0	Start Command-Mode
	0x1C	Konfigurationsparameter mit I2C-Adresse auslesen
	0x5C	Konfigurationsparameter mit I2C-Adresse schreiben
	0x80	Ende Command-Mode

Die beiden Bytes für Command Data enthalten bei schreibendem Zugriff die Daten und müssen bei lesendem Zugriff 0x00 sein.

Die Antwort auf die Command-Mode Nachrichten können mittels Data-Fetch ausgelesen werden. Die Responsetime für die Command-Mode Nachrichten betragen jeweils 100µs.

In Tabelle 2 ist die Antwort auf das Starten des Command-Modes dargestellt.

S	6	5	4	3	2	1	0	R	A	7	6	5	4	3	2	1	0	N	P
S	0	1	0	1	0	0	0	0	A	S	S	D	D	D	D	R	R	N	P
	Slave Address									Status		Diagnostic				Response			

Tabelle 2

Status:	10_b – Command-Mode
	01_b – Stale
Diagnostic:	$xxx1_b$ – korrigierter EEPROM-Fehler
	$xx1x_b$ – nicht korrigierbarer EEPROM-Fehler
	$x1xx_b$ – RAM Parity Fehler
	$1xxx_b$ – Konfigurationsfehler
Response:	00_b – busy
	01_b – positives Acknowledge
	10_b – negatives Acknowledge

In Tabelle 3 ist die Antwort auf das Auslesen der I2C-Adresse dargestellt.

S	6	5	4	3	2	1	0	R	A	7	6	5	4	3	2	1	0	A	7	6	5	4	3	2	1	0	A	7	6	5	4	3	2	1	0	A	P
S	0	1	0	1	0	0	0	0	A	S	S	D	D	D	D	R	R	A	E	E	E	E	E	E	E	E	A	E	E	E	E	E	E	E	E	A	P
	Slave Address									Status		Diagnostic				Response			EEPROM Data [15:8]									EEPROM Data [7:0]									

Tabelle 3

Status: siehe Tabelle 2

Diagnostic: siehe Tabelle 2

Response: siehe Tabelle 2

EEPROM-Data: Inhalt der Speicherzellen

Die Antwort auf das Command-Byte 0x1C enthält in den Bits 6:0 die I2C-Adresse, der Basiswert ist 0101000b. Die anderen Bits enthalten weitere Konfigurationseinstellungen. Solange sich der Sensor im Konfigurationsmodus befindet ist die alte Adresse gültig.

Im Folgenden ist der komplette Vorgang für das Auslesen und zurückschreiben der I2C-Adresse aufgeführt:

Power – On Reset										
S	0x50	A	0xA0	A	0x00	A	0x00	N	P	Start Command – Mode
S	0x51	A	0x81	N	P					Antwort (ACK)
S	0x50	A	0x1C	A	0x00	A	0x00	N	P	Konfigurationsword mit Adresse auslesen
S	0x51	A	0x81	A	Highbyte	A	Lowbyte	N	P	Antwort
Die Bits 6:0 im Lowbyte durch die neue Adresse ersetzen										
S	0x50	A	0x5C	A	Highbyte	A	Lowbyte	N	P	Neuen Konfigurationswert schreiben
S	0x51	A	0x81	N	P					Antwort (ACK)
S	0x50	A	0x80	A	0x00	A	0x00	N	P	Start normaler Modus
Oder alternativ Power – Off										

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