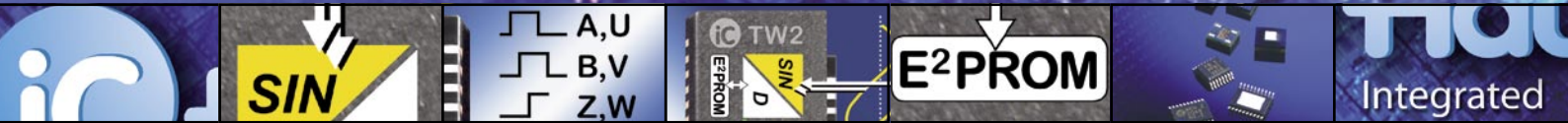
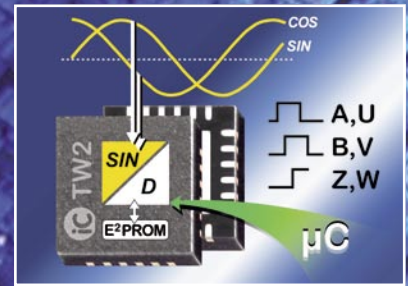


# iC-TW2

## 8-BIT SIN/COS INTERPOLATION IC WITH INTEGRATED EEPROM



iC-TW2 is a configurable interpolation and signal conditioning device featuring encoder quadrature and motor commutation output signals. The chip includes an on-chip EEPROM for permanent storage of setup and calibration parameters and is accessible via serial microcontroller interfaces. The chip operates on single-ended supplies of 3.3 V and 5 V.

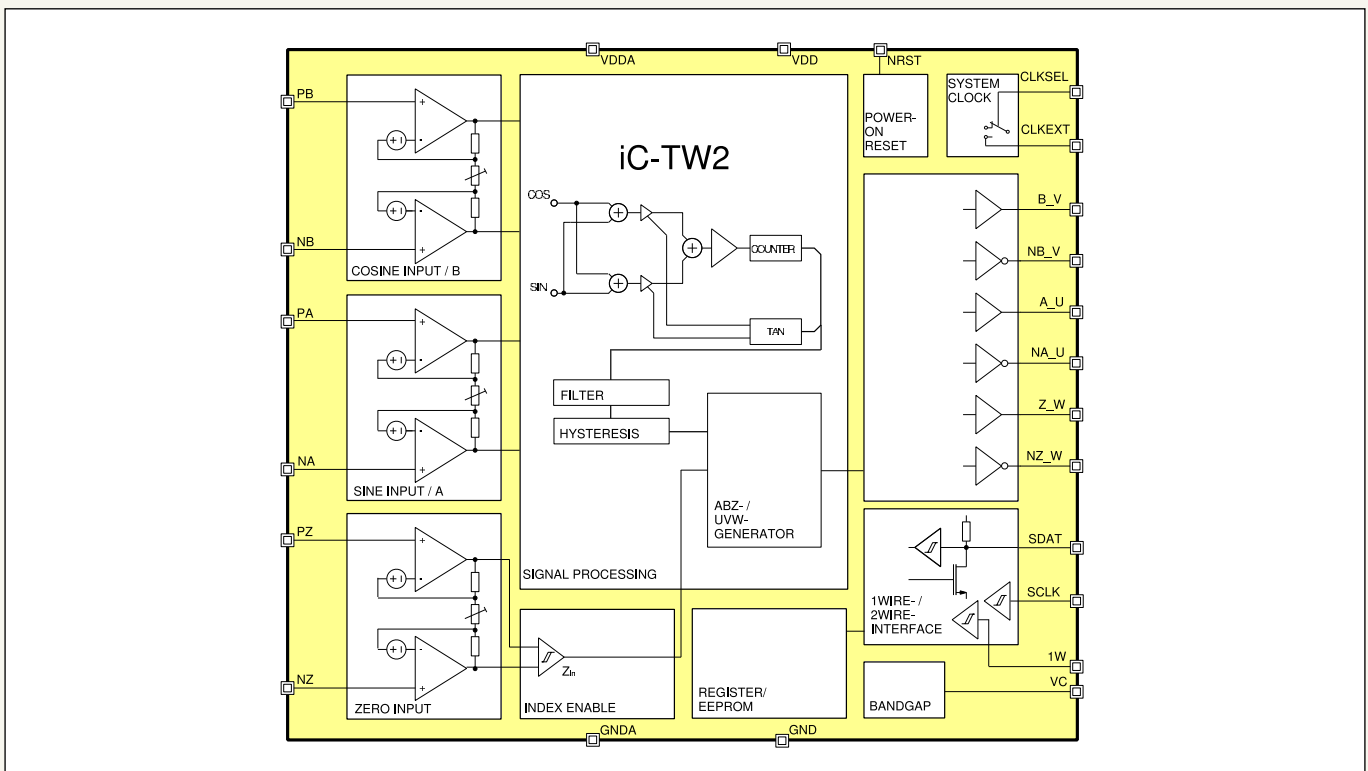
The interpolation engine interfaces differential sensor bridges with no external components required. Single-ended sensor signals are supported by tying the negative input to the signal reference, usually VDD/2.

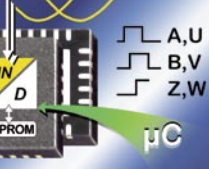
### Applications

- Optical and magnetic position sensors
- Rotary encoders
- Linear encoders

### Features

- Programmable real-time interpolation
- Freely selectable interpolation factors of x0.25 to x64 (resolution from 1 to 256 angle steps)
- Differential inputs and programmable instrumentation amps
- Selectable gain permits single-ended and differential signals (10 mVpp to 1.5 Vpp)
- Input frequency to 115 kHz at highest resolution
- Four incremental output modes: encoder quadrature with index, up/down clock, increment/direction, 3-phase commutation
- Easy microcontroller access via SPI and single-wire interface
- Single-ended supply of 3.3 V and 5 V, low power consumption
- No external components required for sensor interface, signal calibration, filtering or EEPROM
- Reduced board space due to small QFN package (4x4 mm)





# iC-TW2 8-BIT SIN/COS INTERPOLATION IC WITH INTEGRATED EEPROM

iC-TW2 has a large offset correction range and therefore requires no external trimming of the used reference signal.

The index inputs accept a differential or single-ended input signal when using a further reference as the switch threshold.

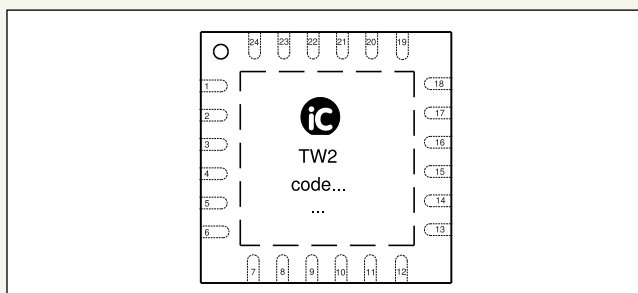
iC-TW2 generates a single index pulse for each input signal period. The index position with respect to the start of the input signal period and also the pulse width thereof can both be programmed.

In addition to the quadrature and 3-phase commutation output modes the chip has two further modes, providing up/down clock signals and, alternatively, increment and direction signals, enabling counters to be interfaced directly.

## Pin Functions

| No. | Name   | Pin Function                                     |
|-----|--------|--|
| 1   | VDD    | +3.3 to +5 V Digital Power Supply                |
| 2   | B_V    | Incremental Output B+ / Commutation Output V     |
| 3   | NB_V   | Incremental Output B- / Signal Output V          |
| 4   | A_U    | Incremental Output A+ / Commutation Output U     |
| 5   | NA_U   | Incremental Output A- / Signal Output U          |
| 6   | GND    | Digital Ground                                   |
| 7   | NZ_W   | Index Output Z- / Signal Output W                |
| 8   | Z_W    | Index Output Z+ / Commutation Output W           |
| 9   | 1W     | Serial 1-Wire Interface, write data input        |
| 10  | VDDA   | +3.3 to +5 V Analog Power Supply                 |
| 11  | GNDA   | Analog Ground                                    |
| 12  | n.c.   | n.c.   |
| 13  | PB     | Pos. Signal Input Channel B (cosine)             |
| 14  | NB     | Neg. Signal Input Channel B (cosine)             |
| 15  | CLKSEL | Clock Source Selection (low: int., high: ext.)   |
| 16  | NRST   | Reset Input (active low)                         |
| 17  | PA     | Pos. Signal Input Channel A (sine)               |
| 18  | NA     | Neg. Signal Input Channel A (sine)               |
| 19  | VC     | Reference Voltage Output (1.21 V)                |
| 20  | NZ     | Neg. Index Enable Input                          |
| 21  | PZ     | Pos. Index Enable Input                          |
| 22  | SCLK   | Serial 2-Wire Interface, clock input             |
| 23  | CLKEXT | External Clock Input                             |
| 24  | SDAT   | Serial 2-Wire Interface, bidirectional data line |

## Pin Configuration QFN24 4 mm x 4 mm



## Key Specifications

| Inputs and Signal Conditioning |   |
|--------------------------------|---|
| Diff. Input Signal Range       | 25 mVpp to 1.5 Vpp  |
| Gain Range                     | 1x to 60x (coarse, A and B)<br>0 dB, 0.6 dB, 1.2 dB, 1.8 dB (fine A, fine B)          |
| Offset Calibration Range       | +/- 50 % in steps of 1.6 %  |
| Permissible Input Frequency    | up to 460 kHz @ IPF <= 16x<br>up to 230 kHz @ IPF <= 32x<br>up to 115 kHz @ IPF > 32x |

| Sine-to-Digital Conversion                       |   |
|--|---|
| Angle Resolutions                                | 1 to 256 steps/period   |
| Interpolation Factors                            | x0.25 to x64  |
| Absolute Angle Accuracy                          | +/- 2.8° @ x64<br>(reduced accuracy modes selectable)                             |
| Angle Hysteresis                                 | 0°, +/- 1.4°, +/- 2.81°, +/- 5.63°  |
| Input-To-Output Latency (at 30 MHz system clock) | 0.53 µs (no filter),<br>0.8 µs (8 sample average),<br>1.06 µs (16 sample average) |

| Incremental Outputs            |   |
|--------------------------------|---|
| Output Operating Modes         | A, B and index Z<br>up clock / down clock<br>increment / direction<br>3-phase commutation |
| Output Characteristics         | TTL/CMOS compatible, +/- 6 mA,<br>tr/td 4 ns @ 3.3 V and CL 10 pF                         |
| A/B Output Min. Phase Distance | 33 ns to 8.5 µs (programmable core clock rate)  |
| Index Signal Position          | adjustable in steps of 1.4°   |
| Index Signal Length            | 1.4° to 360°, adjustable in steps of 1.4°   |
| Commutation Signal U           | start angle adjustable in steps of 1.4°   |
| Commutation Signal V, W        | adj. correction of up to +/- 11° vs. U  |

| Controller Interfaces |   |
|-----------------------|---|
| 1-Wire Interface      | write only access to register bank and EEPROM, directly connectable with IR phototransistor as a rugged "in-field" programming port |
| 2-Wire Interface      | SPI compatible, read/write access to register bank and EEPROM   |

| Other Operational Data  |  |
|-------------------------|--|
| Supply Voltage          | single 3.3 V to 5 V supply   |
| Operational Temp. Range | -40 to +125 °C   |
| On-Chip System Clock    | typ. 30 MHz @ 5V, 25 °C  |
| Package                 | QFN24 (4 mm x 4 mm)  |
| Device Configuration    | via 1-wire serial interface (write only)<br>via 2-wire serial interface (read/write)                     |
| On-Chip EEPROM          | 8x 32 bit, 3x 32 bit reserved section to take OEM data, e.g. serial number and manufacturing information |
| Calibration Modes       | gain and offset,<br>oscillator and index window  |