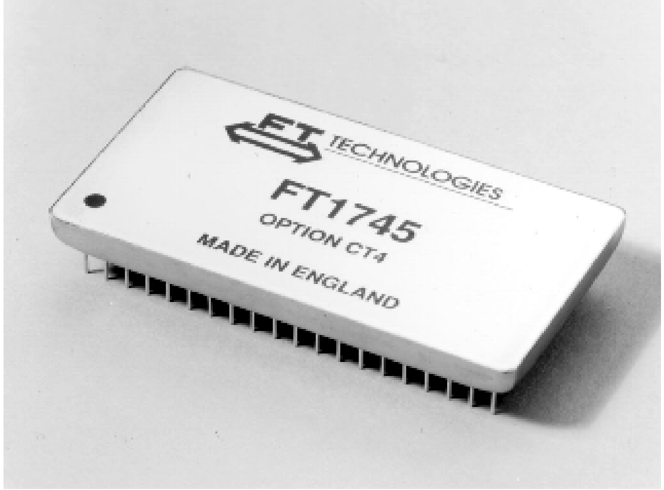
FT1745

Low-Profile 2VA Digital-to-Resolver Converter

Features

- ±2 or ±4 Arc Minute Accuracy
- 14-Bit Resolution
- 2VA Output Power with Remote Sense
- dc-2.6kHz Reference Frequency
- Low Quiescent Power Dissipation
- Fully De-glitched Outputs
- Full Protection Against Output Short Circuits and Load Induced Voltage Transients
- Input Latches with Hi and Lo Byte Enable
- -40°C to +85°C Operating Temperature Range
- Compact 40 pin Dual-in-Line Kovar Package
- Reference Input and Signal Output Transformer Set Available
- Pin compatible with Analog Devices DRC1745



Applications

The FT1745 is ideal for use in applications requiring a digitally controlled synchro or resolver control transmitter (CX) output, such as:

- Servo System Controllers
- Avionics Equipment
- Synchro and Resolver Test Equipment
- Synchro Retransmission Systems
- Flight Simulators
- Sine/Cosine Function Generators

Description

Introduction

The FT1745 is a 14-bit resolution Digital-to-Resolver Converter (DRC) designed for driving control transformer (CT) and control differential transmitter (CDX) loads with power ratings of up to 2VA.

The FT1745 converts parallel digital data, representing shaft angle information, into a resolver (sine and cosine) format output with a conversion accuracy of ±2 or ±4 arc minutes depending on the option selected (see Ordering Information).

The digital input port of the FT1745 is compatible with either 5V CMOS (option /C) or LS TTL (option /L) logic levels and features a data latch for ease of interfacing to either 8- or 16-bit microprocessor-based systems.

The analogue (reference) input port accepts a 3.4V rms signal in the frequency range dc - 2.6kHz and is fully protected against overvoltage. No damage will occur to the converter if a reference signal is applied when the power supply voltages are not present.

The FT1745 incorporates a special de-glitching circuit which eliminates the voltage spikes which often appear on the output signals of digital-to-resolver converters, particularly when high rotation rates are being generated.

The no-load internal power dissipation of the FT1745 is under 200mW, which is typically less than 25% of the dissipation of other digital-to-resolver converters with similar output drive capabilities. In applications where the converter output is lightly loaded, such as when driving solid-state synchro- or resolver-to-digital converters, additional heat sinking is usually unnecessary.

The output stage power amplifier is fully protected against output short circuits and voltage transients. A remote sensing facility is also provided which reduces angular errors when driving loads connected to the converter via long cable runs.

Reference input and signal output encapsulated transformer modules are available to allow the FT1745 to interface with systems operating at voltage levels of 11.8V, 26V, 90V and 115V. Output transformer modules are available configured for either resolver-to-resolver or resolver-to-synchro (Scott-T) operation. See data sheet - *FT1680, FT1683 Low-Profile, Synchro/Resolver Transformer Modules* for further information on the available options.

Using the FT1745

Operating Principle

In operation the FT1745 accepts an analogue reference input signal which is buffered and then applied to precision sine and cosine multipliers. The coefficients of the multipliers are determined by the value of the digital input word (see Table 1). The multiplier outputs are then applied to unity gain power buffers to produce the 6.8V, 2VA output. A block diagram of the FT1745 is shown in Figure 1.

The SIN and COS outputs of the converter are related to the reference input signal and the digital input word by the following expressions:

$$V_{out}\,(SIN) = 2\ V_p Sin\omega t\ Sin\Theta \quad ....(1)$$
$$V_{out}\,(COS) = 2\ V_p Sin\omega t\ Cos\Theta \quad ....(2)$$

where:
$V_p Sin\omega t$ = reference input signal (V_p = 4.81V for rated output)
Θ = digital angle

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FT Technologies Ltd Church Lane, Teddington, Middlesex, TW11 8PA, England. Tel: 0181-943 0801 Fax: 0181-943 3283
E-mail: sales@fttech.co.uk Web: http://www.fttech.co.uk

FT1745 Specification (Typical @ 25°C unless otherwise stated)

Digital Inputs[1]

Digital Data Input Resolution	14-bits
Digital Data Input Format	Parallel natural binary, positive logic, 5V CMOS/TTL compatible
Data Latch Control, HBE & LBE	Logic 1 = latches transparent, Logic 0 = inhibit updating
Data Latch Control, Setup & Hold Times	t_{setup} = 15ns, t_{hold} = 10ns

Analogue Input (V_{REF})[2]

Voltage[3]	3.4V rms (for rated output voltage)
Frequency Range	dc - 2.6 kHz
Input Impedance	10kΩ
V_{REF} to V_{OUT} Gain	2 ± 0.2%
Gain Temperature Coefficient	25 ppm/°C (max)
V_{REF} to V_{OUT} Phase Shift (400Hz)	0.3°

Analogue Output (V_{OUT})

Format[4]	Resolver (Sine and Cosine)
Voltage[4]	6.8V rms (at rated analogue input)
Drive Capability	2VA
Angular Accuracy	±2 or ±4 arc minutes (max) - see Ordering Information
Impedance	10mΩ
Offset Voltage	10mV, 20mV (max)
Offset Voltage Drift	50µV/°C
Over voltage Protection	Ultra-fast voltage clamps for protection against load induced transient voltages
Over current Protection	Over current limit set at 450mA
Vector Accuracy	0.03%
Step Response (180° step change)	20µs to rated accuracy

Power Supplies

	CMOS Digital I/P ('C' Option)	LS TTL Digital I/P ('L' Option)
+15V	6mA[5]	4mA
-15V	4mA	4mA
+5V	not applicable	12mA[5]
+15V(P), no load	1mA	1mA
-15V(P), no load	1mA	1mA
+15V(P), 2VA load	415mA (peak)	415mA (peak)
-15V(P), 2VA load	415mA (peak)	415mA (peak)
+15V(P), -15V(P) dc Pedestal (pulsating power supply operation only)	3V dc (min.)	3V dc (min.)

Thermal Characteristics[6]

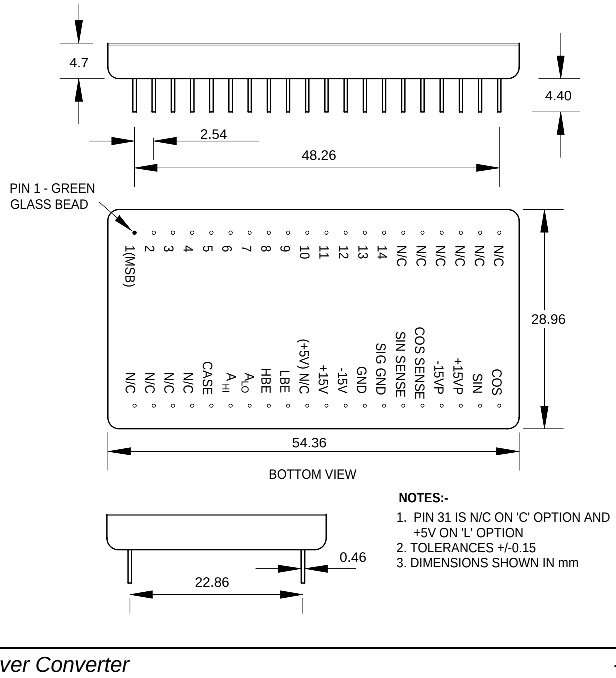
Operating Temperature Range	-40°C to 85°C
Storage Temperature Range	-55°C to 125°C
Thermal Resistance, case to ambient, $R_{\theta CA}$	30°C/W
Thermal Resistance, junction to case, $R_{\theta JC}$	12°C/W (at 0°, 90°,180°, 270°), 6°C/W (at 45°,135°, 225°, 315°)
Maximum Junction Temperature	150°C

Packaging

Type	40 pin DIL hermetically sealed KOVAR package
Dimensions	29.0 x 54.4 x 4.7 mm excl. pins - see Outline Drawing
Weight	25 g

Notes

1. All digital inputs have 100kΩ (typ.) pull-ups to +5V
2. No damage will result to the device if a signal is applied to the Analogue Input when the supply rails are not present.
3. For 11.8V, 26V or 115V reference inputs use appropriate FT1680 step-down, low-profile transformer module.
4. For synchro or resolver format output at 11.8V, 26V or 90V use appropriate FT1683 low-profile output transformer module.
5. Supply current on the +15V rail (CMOS option) and +5V rail (LS TTL option) increases with increasing data update rate. These rails will draw an additional 3.5mA per 100k data updates per second.
6. Depending on the converter load, heat sinking may be required to maintain the case temperature below 85°C
7. Specifications subject to change without notice



Absolute Maximum Ratings

+15V to Gnd	+18V
-15V to Gnd	-18V
+5V to Gnd	-0.5V, +6V
+15V(P) to -15V(P)	40V
Digital Inputs to Gnd	-0.5V, +6V
Analogue Input to Gnd	10V rms

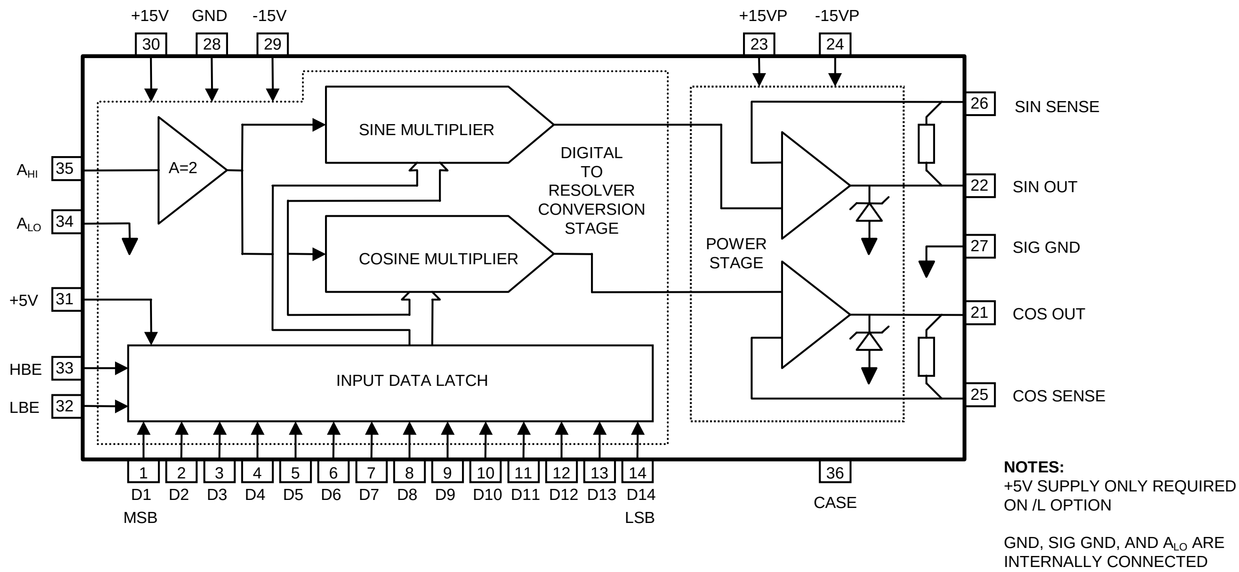


Figure 1 FT1745 Block Diagram

		Weighting	
Bit No.	**Pin No.**	**Degrees**	**Arc Minutes**
1 (MSB)	1	180.000	10,800
2	2	90.000	5,400
3	3	45.000	2,700
4	4	22.500	1,350
5	5	11.250	675
6	6	5.625	337.50
7	7	2.813	168.75
8	8	1.406	84.38
9	9	0.703	42.19
10	10	0.352	21.09
11	11	0.176	10.55
12	12	0.088	5.27
13	13	0.044	2.64
14 (LSB)	14	0.021973	1.31836

Table 1. Bit Weightings

Reference Input

A 3.4V (rms) signal should be applied to the reference input, A_{HI}, of the FT1745. The frequency of the reference signal should be in the range dc - 2.6kHz.

If transformer coupling is used at the converter output, care must be taken to ensure that there is no dc component present on the reference signal as this input is dc-coupled.

Reference voltages of less that 3.4V (rms) can be applied directly to the converter. However, both the signal output voltage and also the available output drive power (converter output current is limited to 450mA) will be reduced in proportion to the reduction in reference voltage.

Reference voltages greater than 3.4V can be easily accommodated either by using the *FT1680 Reference Input Transformer Module* or by resistively scaling. To scale resistively the reference input for a reference voltage, V_{in}, add a scaling resistor, R_S, in series with A_{HI}. The required resistor value is given by:

$$R_S = \frac{(V_{in} - 3.4)}{3.4} \times 10k\Omega \quad .... (3)$$

For example, to scale the reference input to accept an 11.8V signal add a 24k9Ω resistor (preferred value) in series with A_{HI} .

Digital Input

The digital input port incorporates a 14-bit wide transparent data latch with independent hi- and low-byte control inputs (logic inputs HBE and LBE respectively). The 8 most significant bits are latched into the converter under the control of the HBE input and the remaining 6 bits by the LBE input. The timing diagram for the digital input port is shown in Figure 2.

Applying a logic 0 to the HBE and LBE inputs will latch the data present at the digital data port into the converter, inhibiting any further updating of the converter output until the control inputs are returned to the logic 1 state.

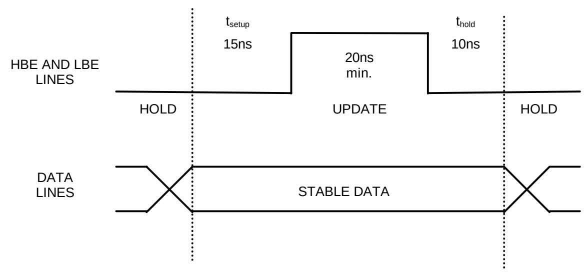


Figure 2 Latch Control Timing Diagram

Both the latch control inputs and the data inputs incorporate internal pull-up circuitry. For applications where timing signals are not available, the HBE and LBE inputs can therefore be left unconnected. In this case, the SIN and COS outputs will be continuously updated to reflect any changes which may occur on the digital input lines. To operate the FT1745 at a resolution of less than 14-bits, connect the unused LSBs to logic 0.

Signal Outputs

The signal outputs from the converter are available at the SIN and COS pins of the device and can either be connected directly to a 6.8V resolver load or, more commonly, to precision step-up transformers. The *FT1683 Synchro/Resolver Transformer Module* can be used to provide one of the standard high-level synchro or resolver line-to-line operating voltages. When, as is usually the case, the load is located remotely from the converter care must be taken with the interconnection wiring to minimise load current related angular errors.

Since the angular accuracy at the load terminals is related to the ratio rather than the absolute values of the SIN and COS signal voltages, any voltage drops caused by the load current in the interconnecting wiring does not directly translate into angular errors. However, any difference in the resistance of the wiring of the SIN and COS runs will give rise to errors at the load terminals.

The FT1745 provides a remote sense facility via the SIN SENSE and COS SENSE pins. By connecting the sense inputs to the corresponding load terminals, see Figure 3, on-load angular errors are reduced. The SIN SENSE and COS SENSE pins should be connected directly to the SIN and COS pins respectively if the remote sense facility is not required.

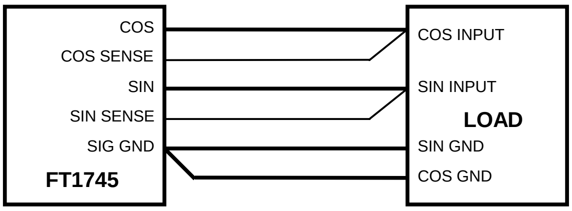


Figure 3 Recommended Load Wiring Arrangement

The signal outputs of the FT1745 are fully protected against both load induced transient voltages and over current fault conditions.

The FT1745 has ultra-fast bi-directional voltage transient suppressors fitted directly between the SIN and COS outputs and SIG GND. These suppressors ensure that when the FT1745 is used to drive inductive loads any transient voltages which may be generated are clamped to a safe level.

Should excessive current be drawn from the signal outputs, the converter will go into current limiting mode. Under current limiting conditions, the output current is reduced to less than 60mA which results in an internal power dissipation of approximately 1W. Once the over current condition is removed, the FT1745 automatically reverts back to the normal mode of operation.

Power Supply Connections

The FT1745/C (CMOS compatible digital inputs) requires only a ±15V DC supply for operation whereas the FT1745/L (LS TTL compatible digital inputs) requires ±15V and +5V supplies.

Separate ±15V supply rail inputs (+15V(P) and -15V(P)) are provided for the power stage section of the FT1745 so that pulsating supplies can be used to drive the power stage if required. The use of a pulsating supply arrangement improves significantly the efficiency of the power amplifiers, resulting in lower internal dissipation under on-load conditions. For further information on using the FT1745 with pulsating supplies please contact the Factory.

If the power stage is to be powered from a DC supply then the ±15V(P) supply inputs can be connected directly to the corresponding ±15V supply inputs.

It is recommended that the ±15V supply rails are decoupled to the GND pin of the converter with 4.7µF tantalum capacitors.

Power Dissipation

The FT1745 is able to drive loads rated at up to 2VA (peak load current 415mA) provided adequate heat sinking is provided. The amount of additional heat sinking required for a given application will depend primarily on the load VA rating, load power factor and ambient operating temperature. It is necessary to provide sufficient heat sinking to limit the case temperature to 85°C.

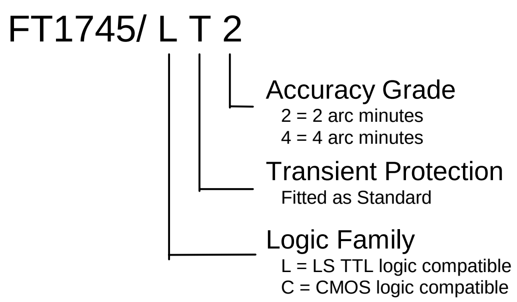
The total internal power dissipation of the converter is given by the following equation:

$$P_t = \frac{2\ V_{dc}\ I_p}{\pi}\left(|\sin\theta| + |\cos\theta|\right) - \frac{V_o\ I_p \cos\alpha}{2} + P_q \quad .... \quad (4)$$

where
- V_o = peak output voltage (V)
- I_p = peak load current (A)
- θ = digital angle (deg)
- α = load phase angle (deg)
- V_{dc} = dc voltage supply (15V)
- P_q = no-load internal dissipation (0.2W typ.)

For a given load, worst case internal dissipation occurs at a digital angle of θ=45° and this value should be used when calculating converter dissipation.

Ordering Information



Related Products

Other synchro/resolver related products manufactured by FT Technologies include angle position indicators, digital (dummy) director units (DDUs) and high accuracy test sets.