

AN2512/D
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1-phase Hall Sensor Decoder
TPU Function (1HD)

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Functional Overview

1-phase Hall Sensor Decoder (1HD) TPU Function is useful for decoding information from a Hall sensor signal in a motion control system. The function uses one input channel to obtain this information for the CPU:

- position in one of two sectors,
- period of last revolution updated 2-times per revolution,

Figure 1 illustrates the functionality.

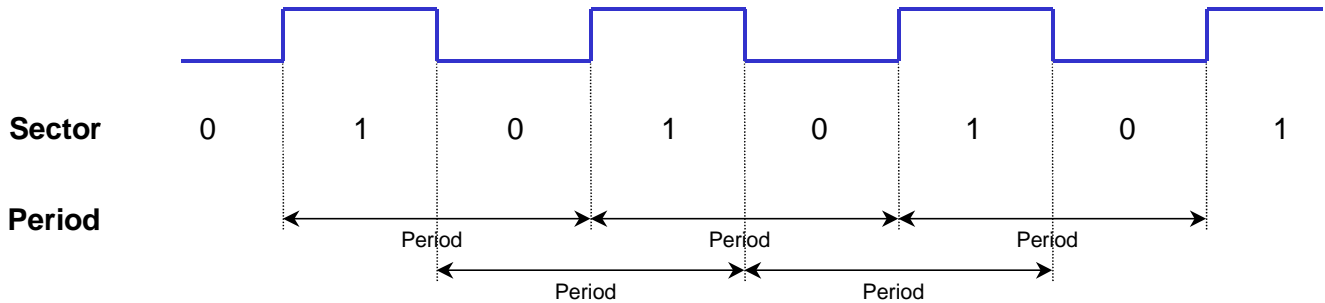


Figure 1. Signal processed by 1HD TPU function and corresponding values

Function Configuration

The 1HD is single-function and not a member of a function set like most of the functions in the MC TPU Library. There are no restrictions on channel assignment – it can run on any channel.

Table 1 shows the configuration options and restrictions.

Table 1. 1HD TPU function configuration options and restrictions

TPU function	How many channels	Assignable channels
1HD	1	any channel

Table 2 shows an example of configuration. The input signal is connected to channel 7. TCR2 clock is selected for all timing operations.

Table 2. Example of configuration

Channel	TPU function	HSQ	Priority
7	1HD	10	low

In this configuration, when no other functions run on the same TPU, the 1HD can receive and process input transitions at a rate of up to 710 kcounts per second at 40MHz IMB clock.

Table 3 shows the TPU function code sizes.

Table 3. TPU function code sizes

TPU function	Code size
1HD	30 μ instructions + 8 entries = 38long words

- Configuration Order** The CPU configures the TPU as follows.
1. Disables the channels by clearing the two channel priority bits on each channel used (not necessary after reset).
 2. Selects the channel functions on all used channels by writing the function numbers to the channel function select bits.
 3. Set the HSQ (Host Sequence) to select the TCR1 or TCR2 clock.
 4. Issues an HSR (Host Service Request) type %10 to initialize the function.
 5. Enables servicing by assigning high, middle or low priority to the channel priority bits.

NOTE: *A CPU routine that configures the TPU can be generated automatically using the MPC500_Quick_Start Graphical Configuration Tool.*

Detailed Function Description

1-phase Hall Sensor Decoder (1HD) The 1HD operates on 1 channel and processes the incoming Hall sensor signal. As a result of this processing, the Sector parameter gets a value that reflects the position of a motion system in one of two sectors. The Sector value can be 0 or 1 and corresponds to the state of the Hall signal.

Each time the sector is changed, the Period value is calculated. The Period value is a TCR time of the last revolution. It is measured from the last edge of the same type (low-high / high-low) to the current edge – see [Figure 1](#). This method eliminates the Hall sensor signal inaccuracies. The Period parameter does not contain correct values during the first revolution after initialization or after a change of direction.

Two function modes are offered:

- TCR1 clock selected
- TCR2 clock selected

The selected mode is determined by the HSQ bit 1.

The function offers interpolation support. The parameters LastEdgeT and ActualT are updated on a Host Service Request HSR = 11. Then the LastEdgeT has the value of the last incoming edge time in TCR clock and the ActualT has the current value of the TCR clock counter.

The CPU program should use 32-bit reads to ensure the coherency of the two parameters. This applies to coherent reads of LastEdgeT and ActualT as well as Sector and TCR_VALUE, which is required for interpolation calculations.

Host Interface

<input type="checkbox"/>	Written By CPU	<input type="checkbox"/>	Written by both CPU and TPU
<input type="checkbox"/>	Written By TPU	<input type="checkbox"/>	Not Used

Table 4. 1HD Control Bits

Name	Options
<div style="display: flex; justify-content: space-around; width: 100px;"> 3210 </div> <div style="display: flex; justify-content: space-around; width: 100px;"> <input type="checkbox"/><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/> </div>	Channel Function Select 1HD function number (Assigned during assembly the DPTRAM code from library TPU functions)
<div style="display: flex; justify-content: space-around; width: 60px;"> 10 </div> <div style="display: flex; justify-content: space-around; width: 60px;"> <input type="checkbox"/><input type="checkbox"/> </div>	Channel Priority 00 – Channel Disabled 01 – Low Priority 10 – Middle Priority 11 – High Priority
<div style="display: flex; justify-content: space-around; width: 60px;"> 10 </div> <div style="display: flex; justify-content: space-around; width: 60px;"> <input type="checkbox"/><input type="checkbox"/> </div>	Host Service Bits (HSR) 00 – No Host Service Request 01 – Not used 10 – Initialization 11 – Get LastEdgeT and ActualT
<div style="display: flex; justify-content: space-around; width: 60px;"> 10 </div> <div style="display: flex; justify-content: space-around; width: 60px;"> <input type="checkbox"/><input type="checkbox"/> </div>	Host Sequence Bits (HSQ) 0x – TCR1 clock selected 1x – TCR2 clock selected
<div style="display: flex; justify-content: space-around; width: 60px;"> 0 </div> <div style="display: flex; justify-content: space-around; width: 60px;"> <input type="checkbox"/> </div>	Channel Interrupt Enable 0 – Channel Interrupt Disabled 1 – Channel Interrupt Enabled
<div style="display: flex; justify-content: space-around; width: 60px;"> 0 </div> <div style="display: flex; justify-content: space-around; width: 60px;"> <input checked="" type="checkbox"/> </div>	Channel Interrupt Status 0 – Interrupt Not Asserted 1 – Interrupt Asserted

TPU function 1HD generates an interrupt each time the Sector is changed.

Table 5. 1HD Parameter RAM

Channel	Parameter	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	LastEdgeT															
	1	ActualT															
	2	TCR_VALUE															
	3	Sector															
	4	Period															
	5																
	6	EdgeT_LH															
	7	EdgeT_HL															

Table 6. 1HD parameter description

Parameter	Format	Description
Parameters written by TPU		
LastEdgeT	16-bit unsigned integer	TCR time of last transition *
ActualT	16-bit unsigned integer	Actual TCR time *
TCR_VALUE	16-bit unsigned integer	TCR time of last transition
Sector	0 or 1	Sector: position in one of two sectors
Period	16-bit unsigned integer	Period: time of last revolution in TCR clocks.
EdgeT_LH	16-bit unsigned integer	TCR time of last low-high transition
EdgeT_HL	16-bit unsigned integer	TCR time of last high-low transition
* The parameter values are entered by TPU on Host Service Request 11 (Get LastEdgeT and ActualT).		

Performance

Table 7. 1HD State Statistics

State	Max IMB Clock Cycles	RAM Accesses by TPU
INIT	18	5
GET_TIME	6	3
LH	14	5
HL	14	5

NOTE: Execution times do not include the time slot transition time (TST = 10 or 14 IMB clocks)

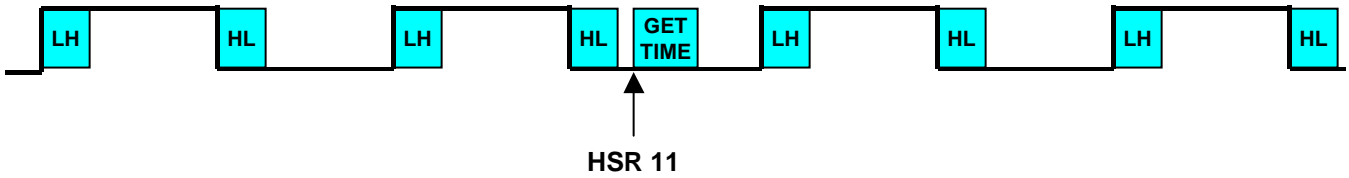


Figure 2. 1HD timing

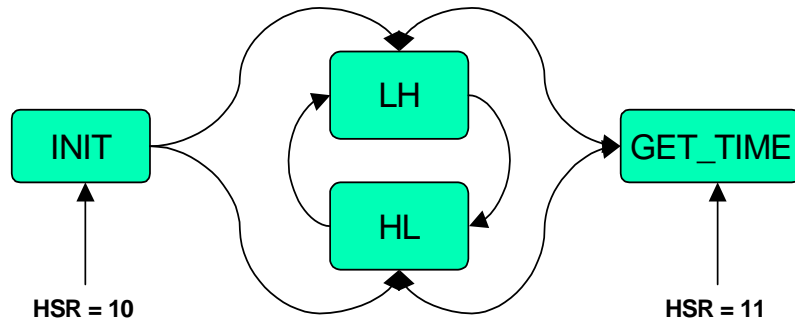


Figure 3. 1HD state diagram



Noise Immunity

The input signals can be disturbed by an impulse noise. The TPU hardware rejects short input pulses of less than a configurable number of IMB clocks. Longer pulses are processed by TPU. Furthermore, the function itself uses a pin history to reject any short error pulse that is long enough to get through the hardware filter, but not long enough to last from the actual transition time to the time that the TPU services the channel. Even longer error pulses are counted on both edges resulting in a short-time error in the Sector value.

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