RX62T

SPWM Motor Control

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Introduction

This document shows how to use RX62T to drive PMSM by Sinusoidal PWM method (SPWM).The system is starting up by 120 degree trapezoidal waveform .Then, changes to use sinusoidal waveform if the conditions which means commutation position counting for six-hundred times in one phase is satisfied.

Target Device

RX62T

Contents

1. System Configuration

The system is uses RX62T RSK and inverter circuit to drive a PMSM (Permanent Magnet Synchronous Motors, PMSM) which is 750 Watt. We used 120 degree trapezoidal waveform control firstly and changed from 120 degree trapezoidal control to sinusoidal waveform control if the commutation position counts for six hundred times in one phase.

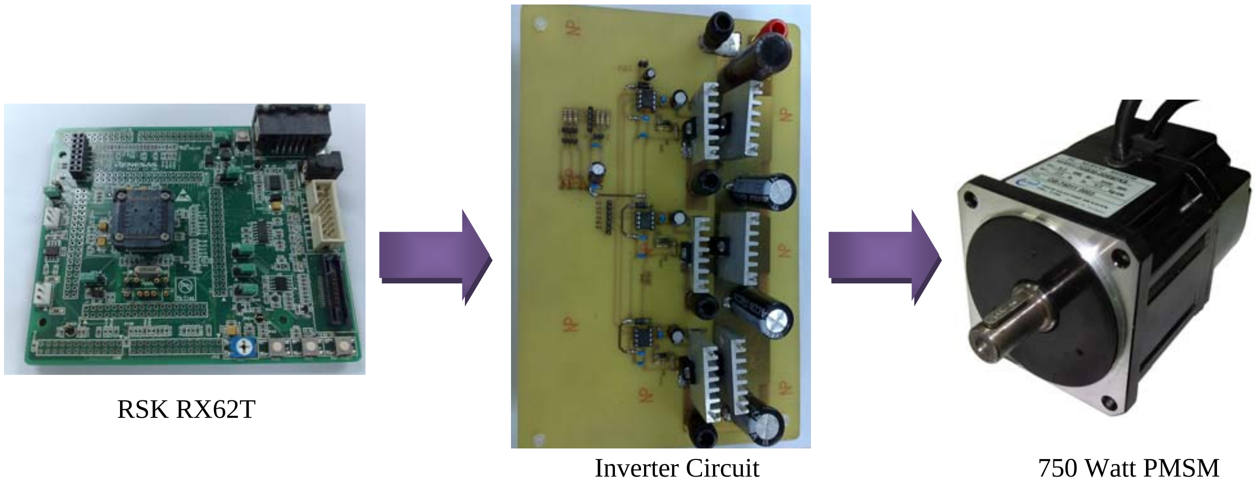


Figure 1-1 System Configuration

Fig. 1-2 shows the driver stage of inverter circuit and Fig. 1.3 shows the inverter circuit. In Fig. 1-2 left part, CHOP_iP and Hin_i2 (i= A, B, C) stand for upper stage of three phase inverter driver; CHOP_iN and Lin_i2 (i = A, B, C) stand for lower stage of three phase inverter driver; in Fig. 1-2 right part, the buffer stage of inverter driver is shown as below. You can find the full inverter circuit in sample code file.

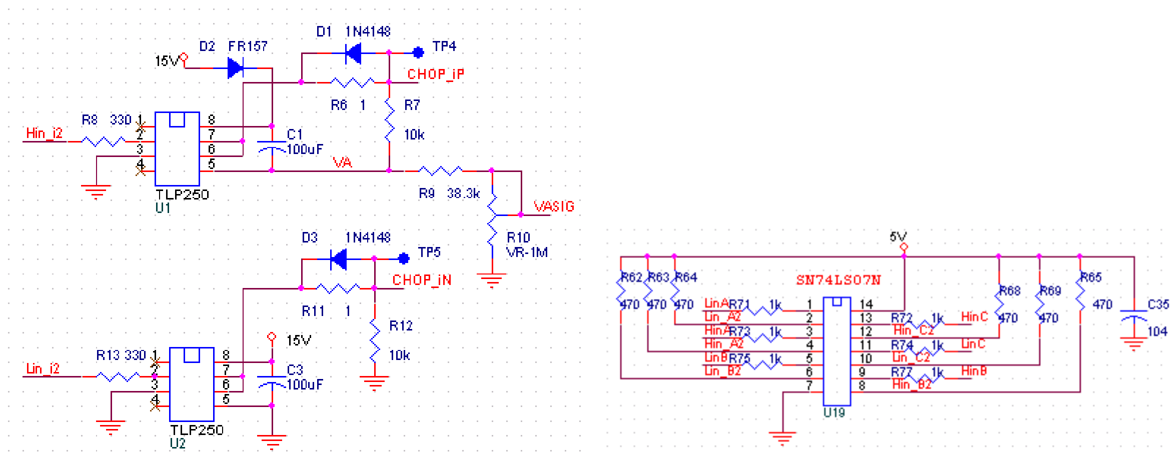


Figure 1-2 Inverter Driver (Left) and buffer stage (Right)

Fig. 1-3 shows the inverter circuit.

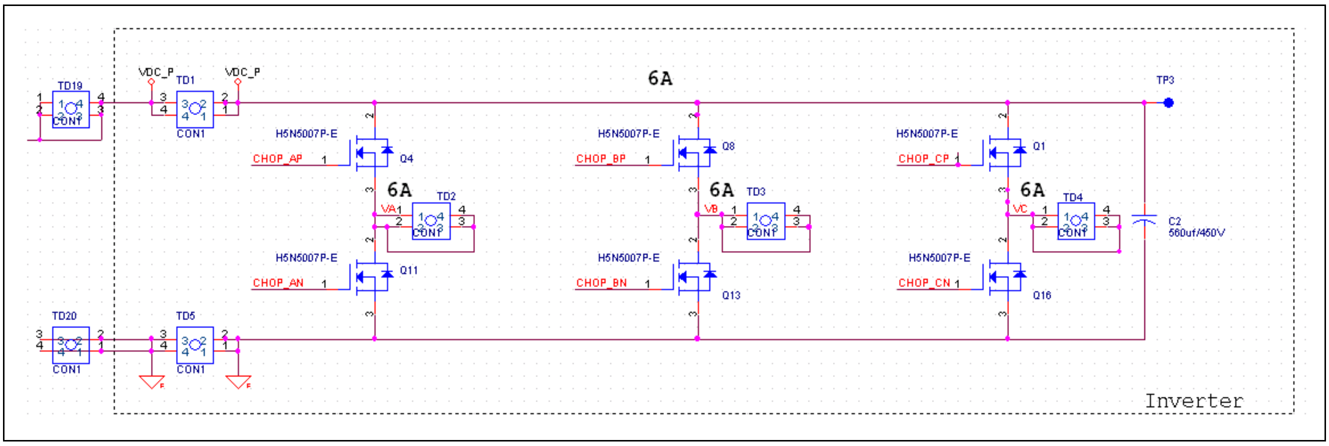


Figure 1-3 Inverter Circuit

Please find the attached file to see the whole inverter circuit.

2. Block Diagram

MTU3 module is used in this application. MTU3 channel 3 and channel 4 are used to drive the motor in complementary mode. Channel 0 is used for calculating the period of the 60electrical degree by detecting the transition of the hall sensor signal. Channel 1 is the timer for one electrical degree. Channel 2 is the timer for thirty degrees. Channel 6 is connected with a low-pass filter to show the current degree of the phase A.

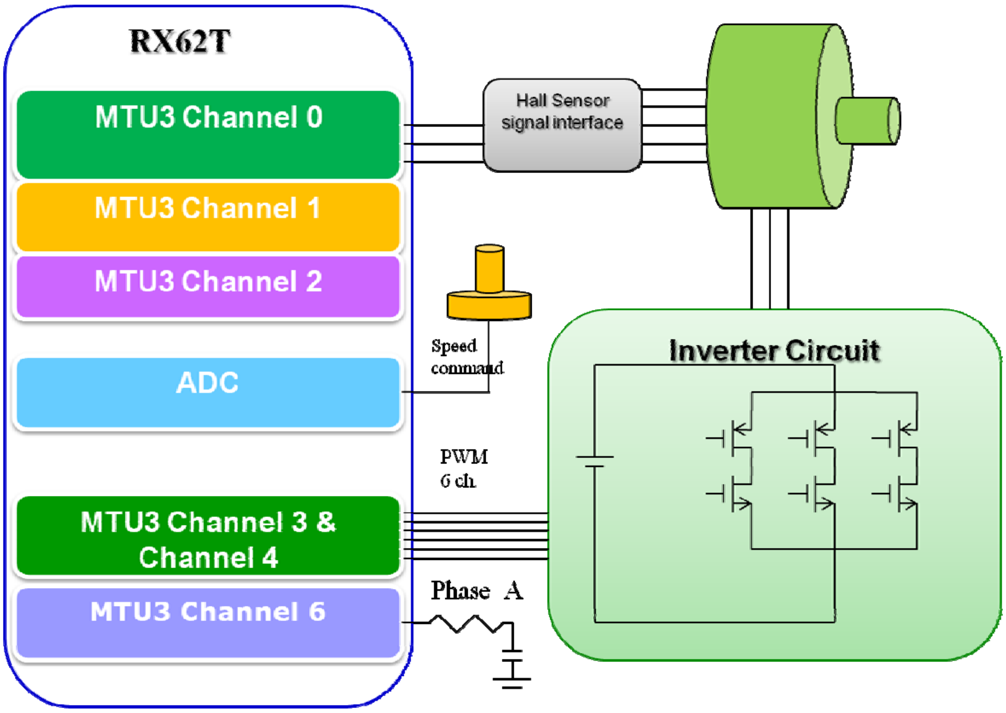
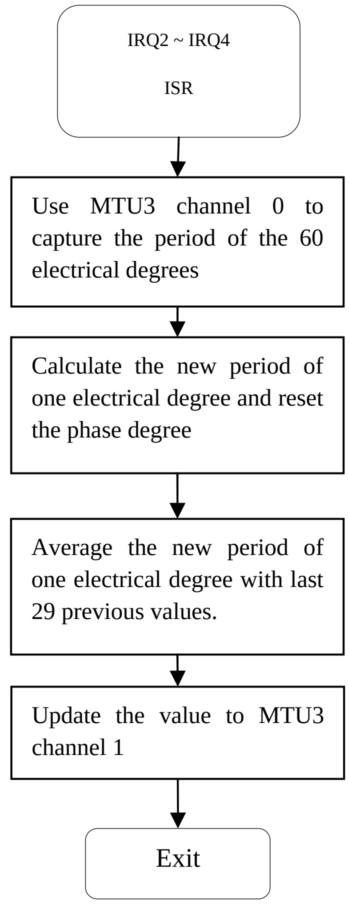


Figure 2-1 Block Diagram

3. Program Flow Chart

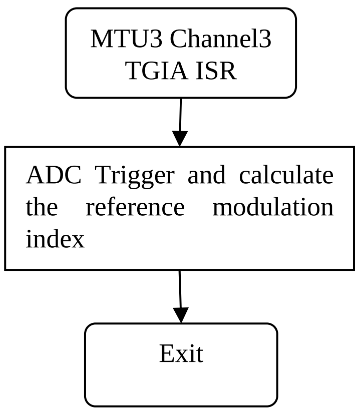
The setting procedure is shown at following flowcharts.



IRQ2, IRQ3, IRQ4 interrupt service routine for hall sensor signal inputs.

1. To use channel 0 as a timer to record the period between two interrupt.
2. Calculate the period of the electrical in one degree from Channel 0.
3. Average the new value with previous one for decrease the tripper.
4. Update the calculated value to channel 1 for one electrical timer.

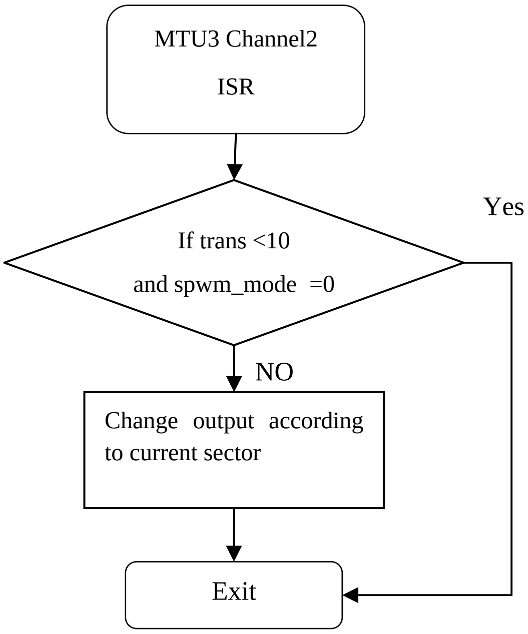
Figure 3 -1 ISR of Hall Sensor Signal Input



Carrier crest interrupt.

ADC operates in one shot mode and trigger ADC to get the reference modulation index 'ma'.

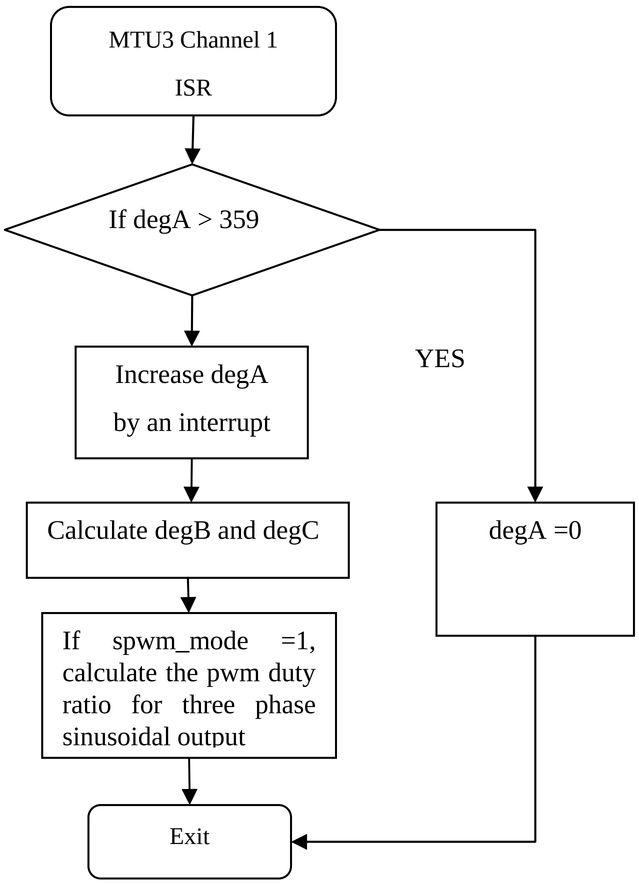
Figure 3-2 Carrier Interrupts (MTU3 channel3 TGIA)



Timer ISR for 30 electrical degree.

1. If flag trans < 10 and flag spwm_mode =0 , disable the function which is to delay the output by the 30 electrical degree.
2. Change the output patterns according current sector.

Figure 3-3 ISR for 30 Electrical Degrees in MTU3 Channel 2



Timer ISR for one electrical degree.

1. Determine the degree value of the phase A is larger than 359 or not.
2. Add the degree of phase A every time.
3. Calculate degrees of phase B and phase C; Correct the degree A.
4. If flag spwm_mode = 1,Calculate the three phase pwm output according to the following equation.

a = ma*sin(theta A)

b = ma*sin(theta B) = ma * sin(theta A +120)

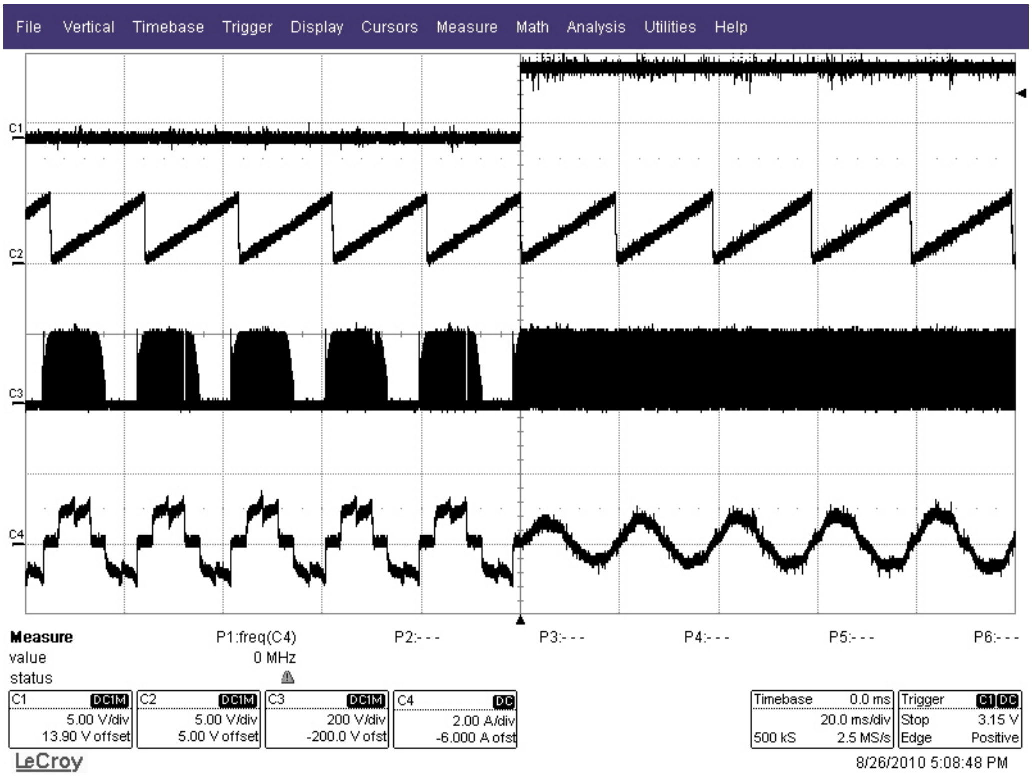
c = ma*sin(theta C) = ma * sin(theta A + 240)

a, b, c: PWM output signal

Figure 3-4 ISR in MTU3 Channel 1

4. Experimental Result

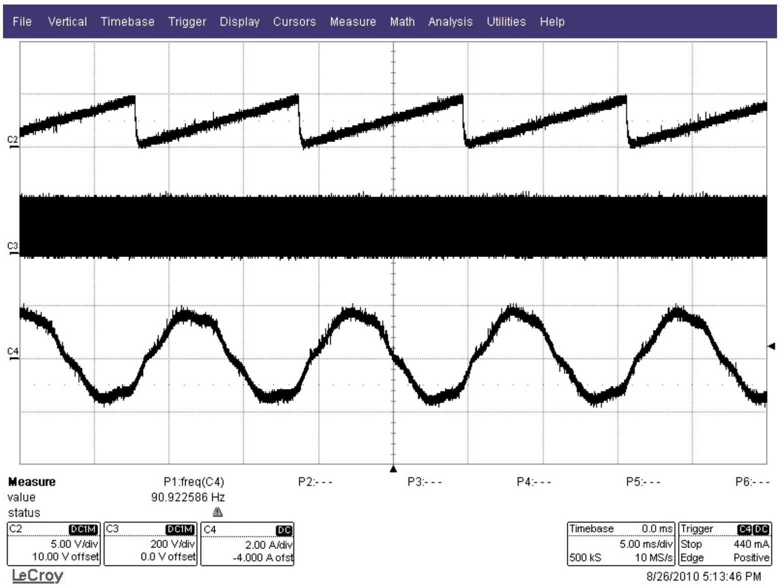
The experimental results are shown as Fig. 4.1 and Fig. 4.2. The system is starting up by 120 degree trapezoidal control and changes to sinusoidal waveform control after the commutation position in phase A counts for six hundred times.



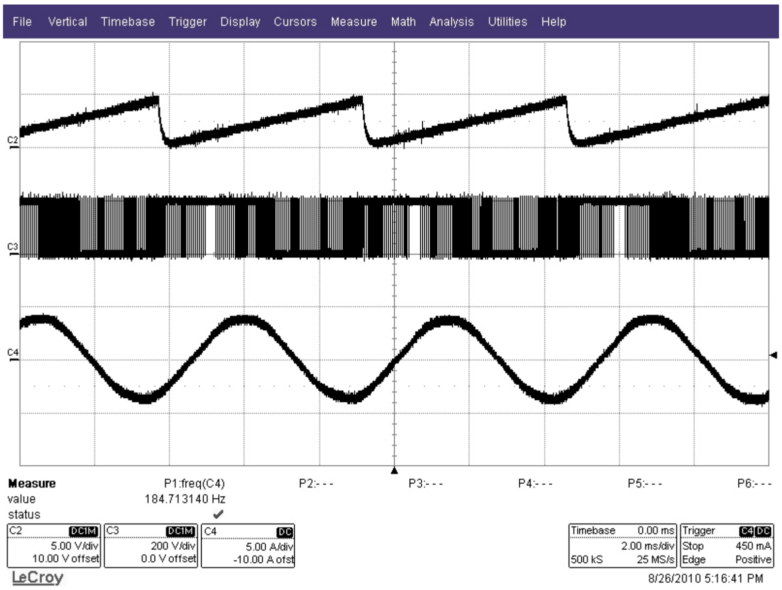
Ch1 : Transition signal for changing to SPWM
Ch2 : Phase A degree(D/A)
Ch3 : Va output
Ch4 : Ia output

Figure 4-1 SPWM Transition

The current waveform will be more similar to pear sinusoidal waveform when the modulation rate is added. See the result at Fig. 4-2.



(a) V_{DC} = 200 V, f_{sw} = 20 kHz, M = 0.4 p.u. for SPWM



(b) V_{DC} = 200 V, f_{sw} = 20 kHz, M = 0.9 p.u. for SPWM

Ch2 : 360 degree(D/A)
Ch3 : Va
Ch4 : Ia

Figure 4-2 Driving Current of the SPWM

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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Jun.07.11	—	First edition issued

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