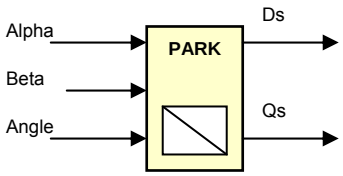
PARK	*Park Variable Transformation*

Description

This transformation converts vectors in balanced 2-phase orthogonal stationary system into orthogonal rotating reference frame.



Availability

This IQ module is available in one interface format:

1) The C interface version

Module Properties

Type: Target Independent, Application Independent

Target Devices: 28x Fixed Point or Piccolo

C Version File Names: park.c, park.h

IQmath library files for C: IQmathLib.h, IQmath.lib

Item	C version	Comments
Code Size□	45/45 words	
Data RAM	0 words•	
xDAIS ready	No	
XDAIS component	No	IALG layer not implemented
Multiple instances	Yes	
Reentrancy	Yes	

• Each pre-initialized "_iq" PARK structure consumes 12 words in the data memory

□ Code size mentioned here is the size of the ***calc()*** function

C Interface

Object Definition

The structure of PARK object is defined by following structure definition

```
typedef struct {  _iq  Alpha;          // Input: stationary d-axis stator variable
                  _iq  Beta;           // Input: stationary q-axis stator variable
                  _iq  Angle;          // Input: rotating angle (pu)
                  _iq  Ds;             // Output: rotating d-axis stator variable
                  _iq  Qs;             // Output: rotating q-axis stator variable
                  void  (*calc)();     // Pointer to calculation function
                } PARK;

typedef PARK *PARK_handle;
```

Item	Name	Description	Format*	Range(Hex)
Inputs	Alpha	Direct axis(d) component of the transformed signal	GLOBAL_Q	80000000-7FFFFFFF
	Beta	Quadrature axis(q) component of the transformed signal	GLOBAL_Q	80000000-7FFFFFFF
	Angle	Phase angle between stationary and rotating frame	GLOBAL_Q	00000000-7FFFFFFF (0 – 360 degree)
Outputs	Ds	Direct axis(D) component of transformed signal in rotating reference frame	GLOBAL_Q	80000000-7FFFFFFF
	Qs	Quadrature axis(Q) component of transformed signal in rotating reference frame	GLOBAL_Q	80000000-7FFFFFFF

*GLOBAL_Q valued between 1 and 30 is defined in the IQmathLib.h header file.

Special Constants and Data types

PARK
The module definition is created as a data type. This makes it convenient to instance an interface to the Park variable transformation. To create multiple instances of the module simply declare variables of type PARK.

PARK_handle
User defined Data type of pointer to PARK module

PARK_DEFAULTS
Structure symbolic constant to initialize PARK module. This provides the initial values to the terminal variables as well as method pointers.

Methods

void park_calc(PARK_handle);

This definition implements one method viz., the Park variable transformation computation function. The input argument to this function is the module handle.

Module Usage

Instantiation
The following example instances two PARK objects
PARK park1, park2;

Initialization
To Instance pre-initialized objects
PARK park1 = PARK_DEFAULTS;
PARK park2 = PARK_DEFAULTS;

Invoking the computation function
park1.calc(&park1);
park2.calc(&park2);

Example

The following pseudo code provides the information about the module usage.

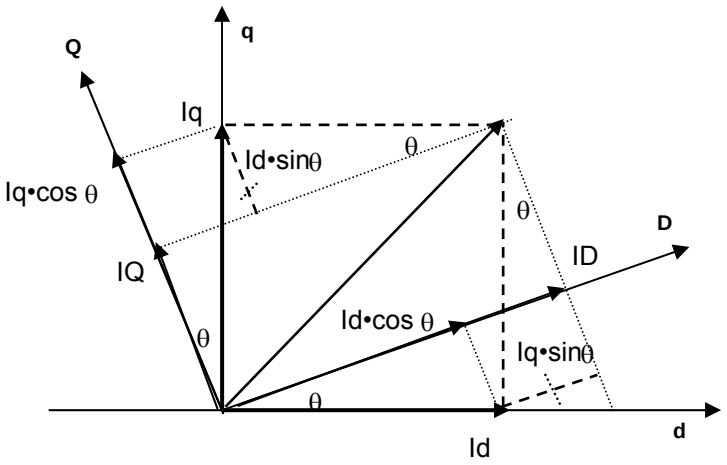
```
main()
{

}

void interrupt periodic_interrupt_isr()
{
        park1.Alpha = ds1;              // Pass inputs to park1
        park1.Beta = qs1;               // Pass inputs to park1
        park1.Angle = ang1;             // Pass inputs to park1

        park2.Alpha = ds2;              // Pass inputs to park2
        park2.Beta = qs2;               // Pass inputs to park2
        park2.Angle = ang2;             // Pass inputs to park2

        park1.calc(&park1);             // Call compute function for park1
        park2.calc(&park2);             // Call compute function for park2

        de1 = park1.Ds;                 // Access the outputs of park1
        qe1 = park1.Qs;                 // Access the outputs of park1

        de2 = park2.Ds;                 // Access the outputs of park2
        qe2 = park2.Qs;                 // Access the outputs of park2

}
```

Technical Background

Implements the following equations:

$$\begin{cases} ID = Id \times \cos\theta + Iq \times \sin\theta \\ IQ = -Id \times \sin\theta + Iq \times \cos\theta \end{cases}$$

This transformation converts vectors in 2-phase orthogonal stationary system into the rotating reference frame as shown in figure below:



The instantaneous input quantities are defined by the following equations:

$$\begin{cases} id = I \times \sin(\omega t) \\ iq = I \times \sin(\omega t + \pi / 2) \end{cases}$$

Next, Table 1 shows the correspondence of notations between variables used here and variables used in the program (i.e., park.c, park.h). The software module requires that both input and output variables are in per unit values.

	Equation Variables	Program Variables
Inputs	id	Alpha
	iq	Beta
	θ	Angle
Outputs	ID	Ds
	IQ	Qs

Table 1: Correspondence of notations