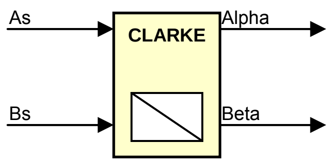
CLARKE — *Clarke Variable Transformation*

Description

Converts balanced three phase quantities into balanced two phase quadrature quantities.



Availability

This IQ module is available in one interface format:

1) The C interface version

Module Properties

Type: Target Independent, Application Independent

Target Devices: x281x or x280x

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

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

Item	C version	Comments
Code Size□ (x281x/x280x)	23/23 words	
Data RAM	0 words•	
xDAIS ready	No	
XDAIS component	No	IALG layer not implemented
Multiple instances	Yes	
Reentrancy	Yes	

• Each pre-initialized "_iq" CLARKE structure consumes 10 words in the data memory

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

C Interface

Object Definition

The structure of CLARKE object is defined by following structure definition

```
typedef struct {  _iq  As;              // Input: phase-a stator variable
                  _iq  Bs;              // Input: phase-b stator variable
                  _iq  Alpha;           // Output: stationary d-axis stator variable
                  _iq  Beta;            // Output: stationary q-axis stator variable
                  void  (*calc)();      // Pointer to calculation function
                } CLARKE;

typedef CLARKE *CLARKE_handle;
```

Item	Name	Description	Format[*]	Range(Hex)
Inputs	As	Phase 'a' component of the balanced three phase quantities	GLOBAL_Q	80000000-7FFFFFFF
	Bs	Phase 'b' component of the balanced three phase quantities	GLOBAL_Q	80000000-7FFFFFFF
Outputs	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

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

Special Constants and Data types

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

CLARKE_handle
User defined Data type of pointer to CLARKE module

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

Methods

void clarke_calc(CLARKE_handle);

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

Module Usage

Instantiation
The following example instances two CLARKE objects
CLARKE clarke1, clarke2;

Initialization

To Instance pre-initialized objects

```
CLARKE clarke1 = CLARKE_DEFAULTS;
CLARKE clarke2 = CLARKE_DEFAULTS;
```

Invoking the computation function

```
clarke1.calc(&clarke1);
clarke2.calc(&clarke2);
```

Example

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

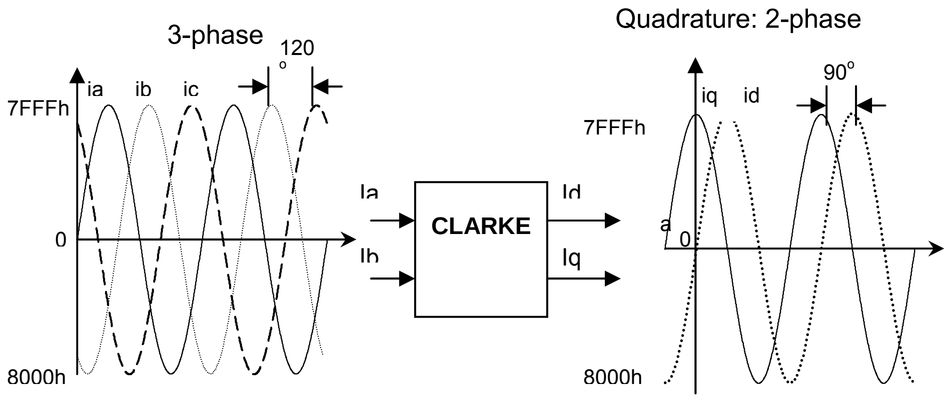
```
main()
{

}

void interrupt periodic_interrupt_isr()
{
        clarke1.As = as1;               // Pass inputs to clarke1
        clarke1.Bs = bs1;               // Pass inputs to clarke1

        clarke2.As = as2;               // Pass inputs to clarke2
        clarke2.Bs = bs2;               // Pass inputs to clarke2

        clarke1.calc(&clarke1);         // Call compute function for clarke1
        clarke2.calc(&clarke2);         // Call compute function for clarke2

        ds1 = clarke1.Alpha;            // Access the outputs of clarke1
        qs1 = clarke1.Beta;             // Access the outputs of clarke1

        ds2 = clarke2.Alpha;            // Access the outputs of clarke2
        qs2 = clarke2.Beta;             // Access the outputs of clarke2
}
```

Technical Background

Implements the following equations:

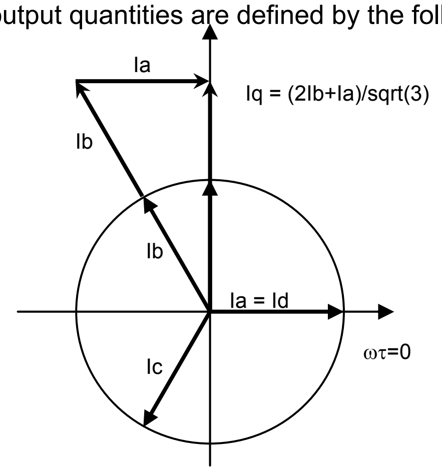
$$\begin{cases} Id = Ia \\ Iq = (2Ib + Ia)/\sqrt{3} \end{cases}$$

This transformation converts balanced three phase quantities into balanced two phase quadrature quantities as shown in figure below:



The instantaneous input and the output quantities are defined by the following equations:

$$ia = I \times \sin(\omega t)$$
$$ib = I \times \sin(\omega t + 2\pi/3)$$
$$ic = I \times \sin(\omega t - 2\pi/3)$$
$$\begin{cases} id = I \times \sin(\omega t) \\ iq = I \times \sin(\omega t + \pi/2) \end{cases}$$



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

	Equation Variables	Program Variables
Inputs	ia	As
	ib	Bs
Outputs	id	Alpha
	iq	Beta

Table 1: Correspondence of notations