SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

OPTICAL AND MICROWAVE ENGINEERING

III YEAR/ VI SEMESTER

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UNIT 3 – MICROWAVE MEASUREMENTS

TOPIC– S PARAMETER MEASUREMENTS

vector signal consists of both amplitude and phase information.
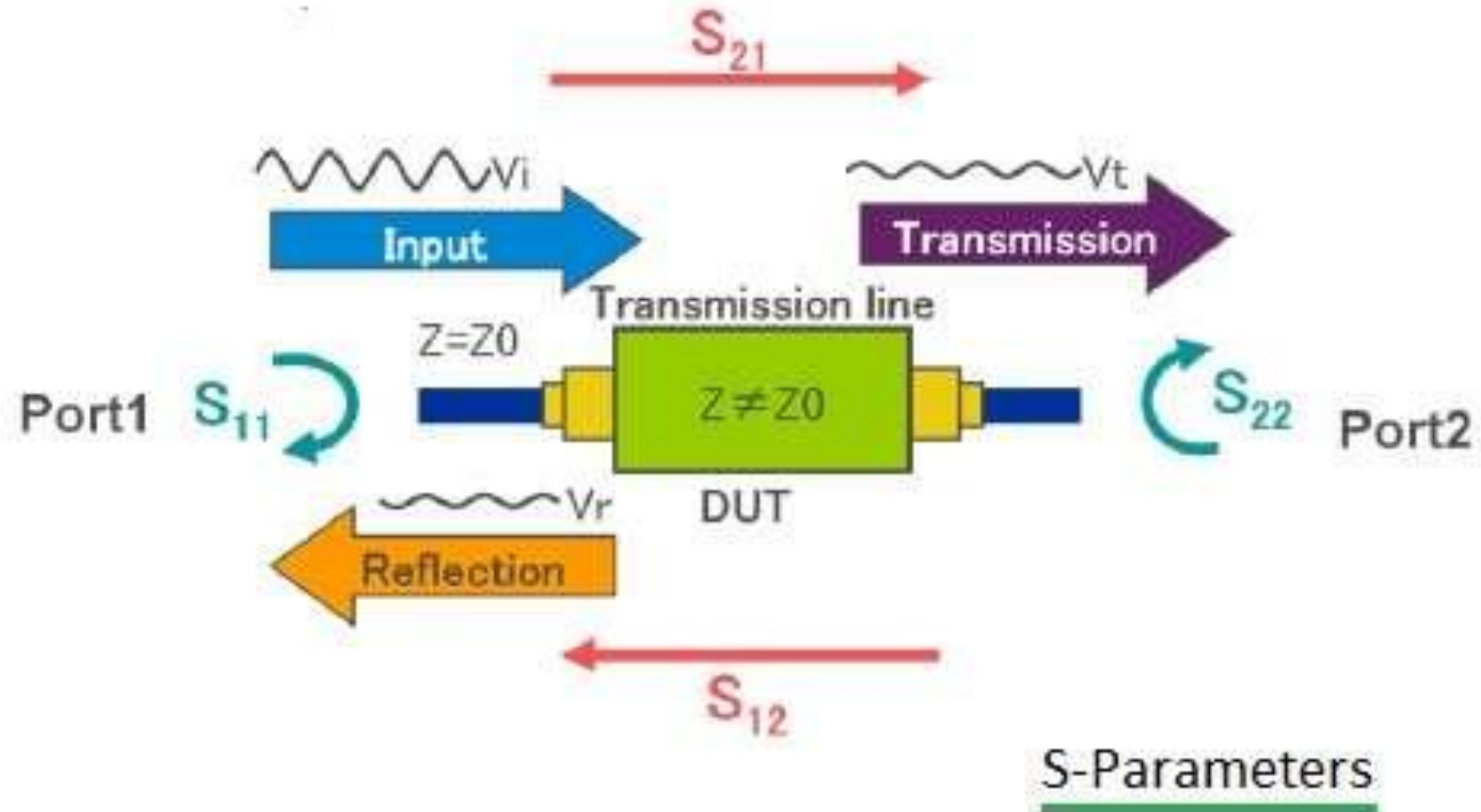
When a signal is passed from linear of non-linear device which we call it DUT (Device Under Test); the characteristics of signal will alter.

The amplitude/phase of output signal is different compare to input signal.

S-parameter convey both of these information i.e. amplitude and phase.

S-PARAMETER MEASUREMENTS

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S-PARAMETER MEASUREMENTS

Amplitude variation information provides insertion loss while timing variation provides phase shift. S parameters are complex matrix which helps us analyzing reflection and transmission characteristics in the frequency domain.

There are four types of S parameters of a two port device.

The convention is letter "S" followed by two numeric digits first one is the port from where output is derived while second one is the port where input is to be fed.

For EXAMPLE: S21 -> Here Port-2 is the output port and Port-1 is the input port.

MEASUREMENT PARAMETERS

Following are the types of S parameter measurements carried out.
• Transmission measurement parameters viz. S11,S22
• Reflection measurement parameters viz. S21, S12

S11 and S22 provides us following useful information.
• Return loss or reflection coefficient,
• Impedance and Admittance,
• VSWR of input and output ports

S21 and S12 provides us following useful information.
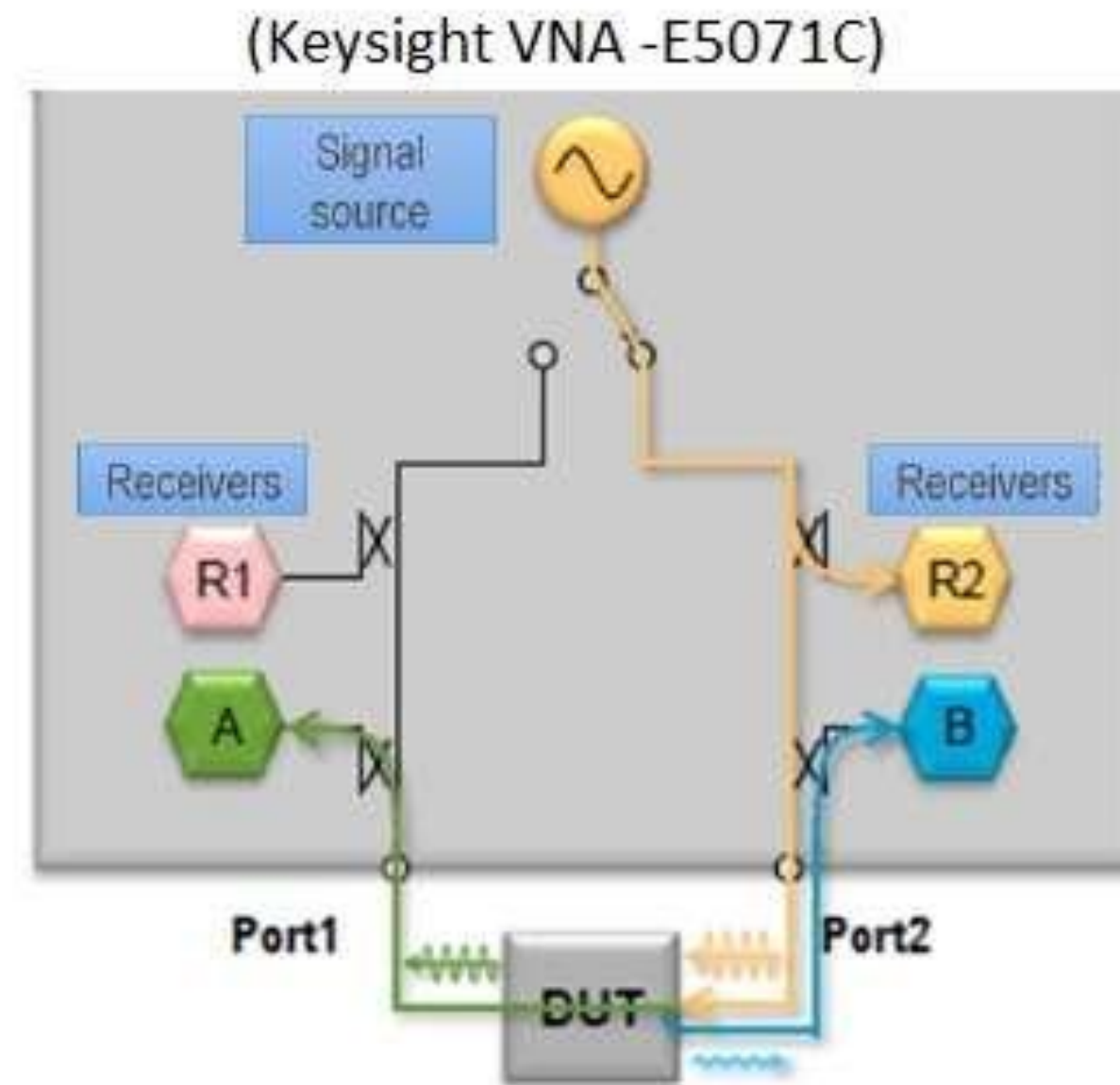• Gain/Loss (i.e. insertion loss),
• Phase and Group Delay(i.e. delay time)

The VNA known as Vector Network Analyzer is used for measurement of S parameters.
The figure-2 depicts internal block diagram of VNA.

(Keysight VNA -E5071C)

Following are the four S parameters measured using this VNA.

➡S11 Input Reflection Coefficient: Measured by taking ratio of A & R1 .

➡S22 Output Reflection Coefficient: Measured by taking ratio of B& R2 .

➡S21 Transmission Insertion loss: Measured by taking ratio of B & R1 . (Output at port-2 and input at port-1)

➡S12 Tranmission Isolation: Measured by taking ratio of A & R2 . (Output at port-1 and input at port-2)

S parameters are obtained by measuring amplitude and phase information using four receivers viz. R1, R2, A, and B inside the Vector Network Analyzer (VNA).

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S11 PARAMETER MEASURE MENT

When measuring S-Parameters on an active circuit you must include all of the biasing components as part of the two port circuit. Input frequencies need to be in the linear region of the circuit.

Two 50 ohm resistors will be needed to act as terminators. For active circuits large DC blocking resistors will need to be used to couple the terminator resistors.

Figures 1 and 2 show the termination resistors, and the DC blocking caps if they are needed. If the circuit is symmetrical, then S11=S22 and S12=S21, so only one measurement need be done.

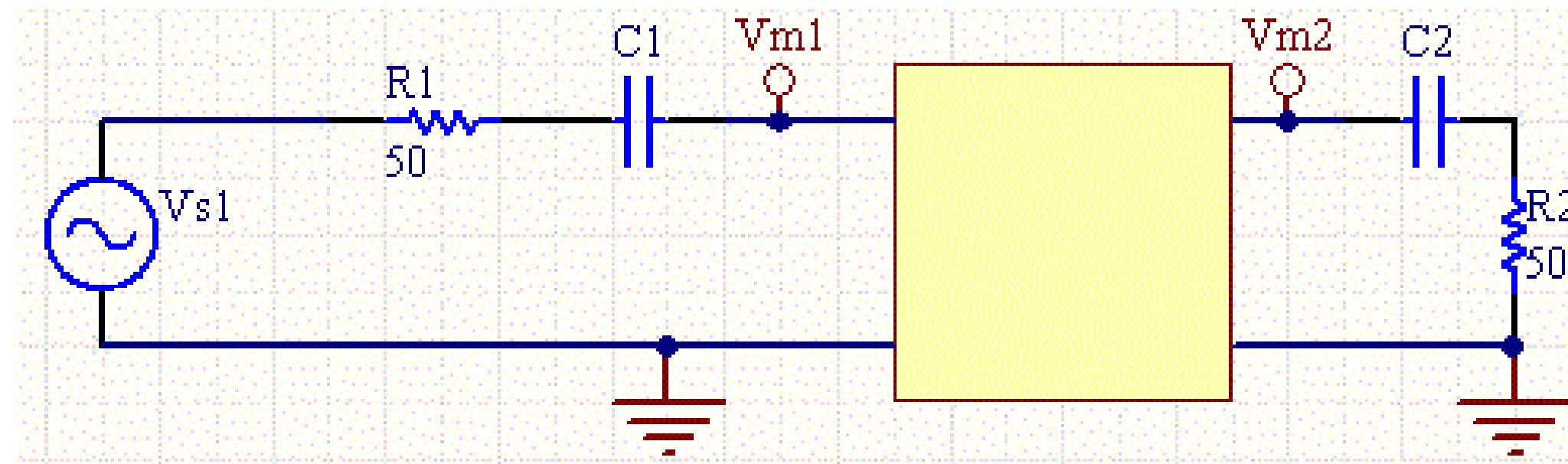**Figure 1: Set up for measuring S-Parameter S11**

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S PARAMETER MEASUREMENT

To make the measurement set the frequency of the function generator to the desired frequency, and measure the source voltage, and Vm1 and Vm2 for both configurations. The phase measurement is the hardest one to make, since it's hard to view small differences in phase on a scope. Then make the following calculations:

S11= 2*Vm1/Vs1-1

S12= 2Vm2/Vs1

S21= 2Vm1/Vs2

S22= 2*Vm2/Vs2-1
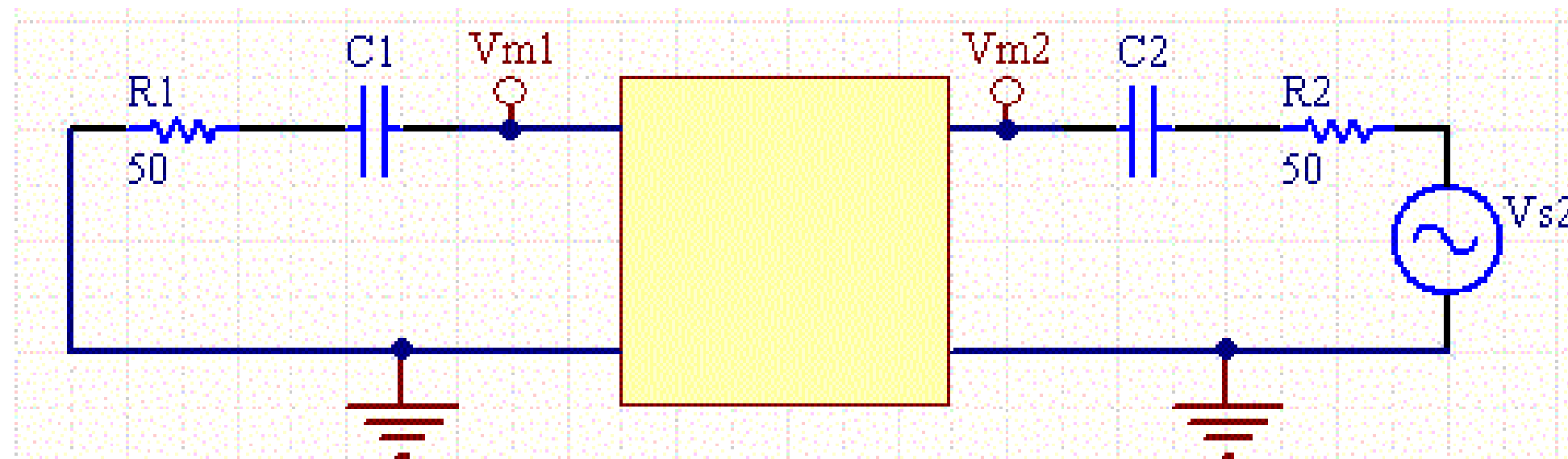
Figure 2: Set up for measuring S-Parameter

REFERENCES

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https://www.daycounter.com/Articles/How-To-Measure-S-Parameters.phtml

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THANK YOU