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PAPR Analysis of FFT and DWT based OFDM using Clipping Technique

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Abstract*— In telecommunications, orthogonal frequency-division multiplexing is a variety of digital transmission and it is a way of encoding digital data on multiple carrier frequencies. Currently in wireless transmission area, Orthogonal Frequency Division Multiplexing (OFDM) is under intense research because of its robustness against multipath fading. However, it's some limitations like the Peak-to-average power ratio (PAPR), which restricts its use. It reduces the efficiency of the system. Few powerful and distortion less peak power reduction schemes for OFDM are One investigated technique is chosen mapping (SLM) where the particular transmit signal is chosen from a group of signals and therefore the second scheme utilizes phase rotated partial transmit sequences (PTS) to construct the transmit signal the third one Amplitude clipping is one amongst the best reduction techniques for PAPR. Amplitude Clipping reduces the height level of the sign to a predetermined value. The aim of this paper is to investigate the performance of system over clipping technique.*

Keywords*— PAPR , FFT-OFDM, clipping in OFDM*

I. INTRODUCTION

Modern Communication systems has increasing demands of high data rates. It is required to enhance transmission and systems to increase the data rates. In different environments different transmission techniques are used to transmit digital signal. Orthogonal Frequency Division Multiplexing system (OFDM) is one of the One of the most considerable techniques and efficient digital signal transmission technique. An Orthogonal Frequency Division Multiplexing (OFDM) system is a multi-carrier system. This system utilizes a multiprocessing technique allowing the simultaneous transmission of data on many closely spaced, orthogonal sub-carriers [1]. Inverse Fast Fourier transform (IFFT) and fast Fourier transform (FFT) during a traditional OFDM system are accustomed multiplex the signals together and decode the signal at the receiver respectively. In this system cyclic prefixes (CP) is added before transmitting the signal. The aim of this will be to increase the delay spread of the channel so it becomes longer than the channel impulse response. Also the aim of this is often to attenuate inter-symbol interference (ISI). Nevertheless, the cyclic prefixes has the disadvantage that it is reducing the spectral containment of the channels [2][3].

Wavelet transforms are considered as alternative platforms for replacing IFFT and FFT. By using the transform, the spectral containment of the channels is healthier since it doesn't use CP. One reasonably wavelet transform is namely as Discrete Wavelet Transform OFDM (DWT-OFDM). It uses (LPF) Low Pass Filter and (HPF) High Pass Filter operating as Quadrature Mirror Filters which are satisfying smooth reconstruction and orthonormal bases properties. Filter coefficients are used by

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the transform as approximate and detail in LPF and HPF respectively. The approximated coefficients is often named as scaling coefficients, whereas, the detailed is observed wavelet coefficients. Sometimes these two filters are called sub-band coding. These signals are divided into sub-signals of low and high frequencies [2] [3].

II. STUDY OF OFDM

Information is collection of symbols and in digital communication each symbol represented in the form group of various size of number of bits. OFDM generate data in spectral space by using some type of quadrature amplitude modulation (QAM) or phase-shift keying (PSK). This modulation also does some processing on the source data like coding for correcting errors, interleaving and mapping of bits onto symbols. Inverse Fast Fourier Transform (IFFT) is more effective for converting the spectra to time domain. IFFT produces samples of a waveform with orthogonal frequency components. Multipath channel has problem of inter symbol interference (ISI). In OFDM ISI is reduced by introducing cyclic prefix between OFDM blocks as a guard interval. Cyclic prefix maintains orthogonally during channel transmission. The Digital to analog converter comprises low-pass filters with bandwidth 1/TS, and TS is the sampling interval. The channel is modelled as an impulse response trailed by the complex additive white Gaussian noise (AWGN). [1] [2] In Channel equalization, the channel can be predictable either by training sequence or sending known pilot symbols at predefined sub-carriers. The receiver get the signal which is then quadrature-mixed down to baseband ,this creates signals cantered on 2fc, so low-pass filters are used to reject these signals .After that analog to digital converters (ADCs) are used foe sampling and digitizing .Time domain samples converted back into a frequency domain by The Fast Fourier Transform (FFT) . The magnitudes of the frequency components correspond to the original data. Lastly, the parallel to serial block converts this parallel data into a serial s to recuperate the original input data. . Figure 1 shows the complete OFDM transmitter receiver block diagram with inverse and forward transforms.

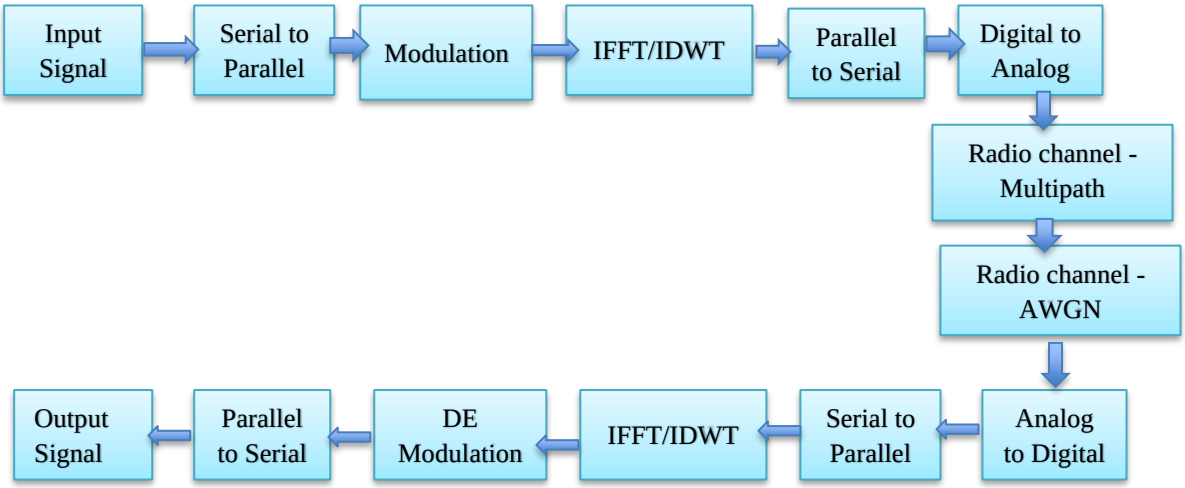

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Fig. 1 An OFDM transmitter -receiver with inverse and forward transform blocks

In DWT-OFDM there is no need to add cyclic prefix into the OFDM code, this will reduce the required bandwidth and transmit data quickly without losing data .Cyclic prefix is required in FFT-OFDM and not required in DWT-OFDM. This is the main difference between FFT-OFDM and DWT-OFDM [4]. In OFDM transmitter Inverse Fast Fourier transform (IFFT) is replaced by inverse discrete wavelet transformation (IDWT) and in OFDM receiver Fast Fourier transform (FFT) is replaced by discrete wavelet transformation (DWT) as shown in figure1.
In DWT-OFDM transmitter, input signal is decomposed in to number of sub band which is defined as approximate coefficients and information. Time and frequency scaling of a signal is studied by these confidents. In low pass filter and high pass filter, these estimated filter coefficients are used by transform. These coefficients are referred as wavelet coefficients [5][6]. Low pass filter and high pass filter separates the signal into low and high-frequency sub-signals respectively. After passing from the channel that affects the signal by Additive white Gaussian noise AWGN , in DWT-OFDM receiver data is converted parallel to serial .After that signal is reconstructed using reconstruction filters that content the wavelet reconstruction . Signal is passes through low pass filter and high pass filter, that does the convolution of the approximate coefficient with low pass filter and detail coefficients with High pass Filter, then generate a sequence as the output decomposition the signal [7].

stem is implemented by combining the different block as shown in Fig. 1.
An OFDM is an Multicarrier Modulation Technique that use a overlap signals to divide the frequency selective channel into a number of narrow band flat fading channel. The FFT encodes the block of symbol; instead of sending the data sequentially on a single carrier at a high symbol rate. The sub-channels are made orthogonal by spacing the subcarrier at the increase of symbol time. The multipath fading can be nullified by making the symbol period of sub-channel longer in their length as compare to multipath delay spread. The signals having high noise and interference is deactivated, thus decreasing the effect of fading and interference. OFDM modulation technique is generated through the use of complex signal processing approaches such as Fast Fourier Transforms (FFTs) and inverse FFTs in the transmitter and receiver sections of the radio. One of the benefits of OFDM is its strength in fighting the adverse effects of multipath propagation with respect to inter-symbol interference in a channel. OFDM is also spectrally efficient because the channels are overlapped and contiguous. The block diagram of OFDM is shown in above figure. In this system input data are FEC coded with technique such as convolution code. The diversity gain is obtained by interleaving the coded bit stream. The constellation points are map after

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III. CHALLENGES IN OFDM

A. Orthogonally:

When carriers are mathematically orthogonal they are actually advantageous so carriers orthogonally can leads to a wrong operation of OFDM systems if not respected. IFFT provides orthogonally carriers with numerical manipulation and if computation error, that could change lightly spacing between consecutive carriers and break the orthogonally of the whole system. . In this case OFDM drops all its efficiency [8][9].

B. Synchronization

In the receiver, incoming signal is to be sampled the properly which is one in all the matter. Fast Fourier Tran Transform might not recover the received knowledge properly, if the incorrect sequence of samples is processed .The problem is additional heavy once the receiver is switched on. Challenges

There is so a requirement for effort temporal order lock. If the signal transmitted is absolutely time domain periodic for the FFT to be properly applied, then the result of the time displacement is to switch the section of all carriers by a proverbial quantity. This can be because of the time shift theorem in convolutional remodel theory. However, the signal isn't very repetitive, the mathematical remodel is performed as if it were repetitive, on the other hand| chosen completely different symbols and transmitted them one when the other. The result of the time shift would then be not solely to feature the section shift spoken on top of, however conjointly to feature some inter symbol interference with adjacent symbols. This interference may hardly degrade reception [8] [9].

C. Peak Average Power Ratio (PAPR)

When the section of various subcarriers add up to make massive peaks, a crucial complication comes in OFDM systems. This downside is termed Peak Average Power Power Ratio (PAPR) and In OFDM systems PAPR will have terribly high values certainly input sets of sample (X n [k]) and overload non-linear characteristics of systems, inflicting inter-modulations among completely different carriers and unsought out-of-band radiation.

Another main disadvantage of PAPR is seen as division noise domination towards the performance of system. This domination is excited by avoiding the clipping result of the most level of the Digital to Analog convertor (DAC) that's set too high. Various techniques square measure projected to scale back PAPR in OFDM signals, however that reduction isn't obvious as a result of PAPR and SNR square measure closely connected.

The PAPR square measure shows the relation between the most powers of associate illustration in

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a very given OFDM transmit image divided by the quality power of that OFDM image. PAPR happens once in a very multi- carrier system the various sub-carriers square measure out 'peak' within the output packet. Because of presence of huge variety of separately modulated sub-carriers in an OFDM system, the height worth of the system is terribly high as compared to the common of the whole system. This magnitude relation of the height to average power is termed as Peak-to Average Power Ratio [8] [9].

IV. PAPR Analysis using Clipping Technique

Clipping the high amplitude peaks is the easy method to reduce the PAPR of OFDM signals. In OFDM signal, PAPR can be reduced by making peak signal lesser than the estimated maximum value. OFDM system constituted with number of sub-carriers and clipping n be applied to any quantity of sub-carriers. In OFDM system, signal peak probability is very minor nevertheless the PAPR is tremendously high. If the widespread of a small peaks is reduced that can help to reduce PAPR. Therefore, clipping process is an effective approach to lower the PAPR. Transmit signal is limited to a pre specified level by applying Clipping and filtering operations on it. Self-interference is produced in clipping techniques and due to that there is degradation in the BER performance. Also out of band radiation is produced in clipping operation which enforces out-of-band interference to adjacent channels [8] [9]. For doing PAPR analysis of FFT and DWT based OFDM by using clipping techniques 3 cases of clipping are taken in to account. These 3 cases are 75% clipping, 65% clipping and 55% clipping

Case 1: Using 75% clipping

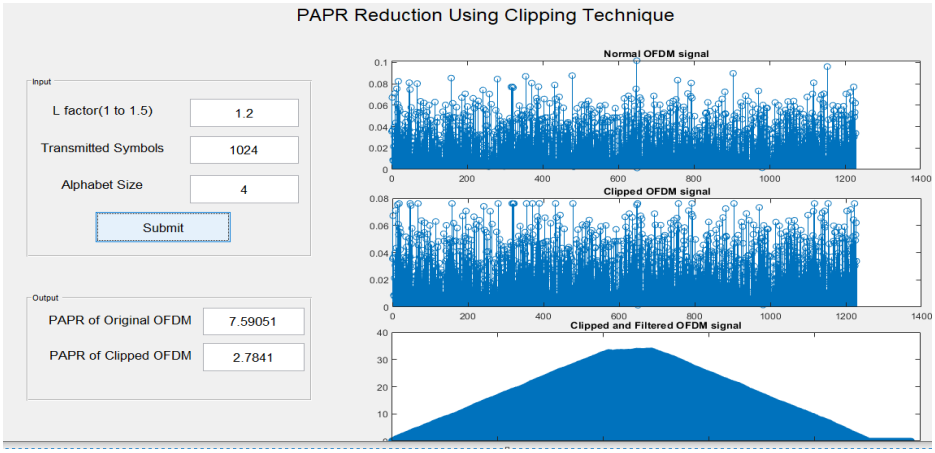

Fig. 2. Case 1: Using 75% Clipping on FFT Based OFDM

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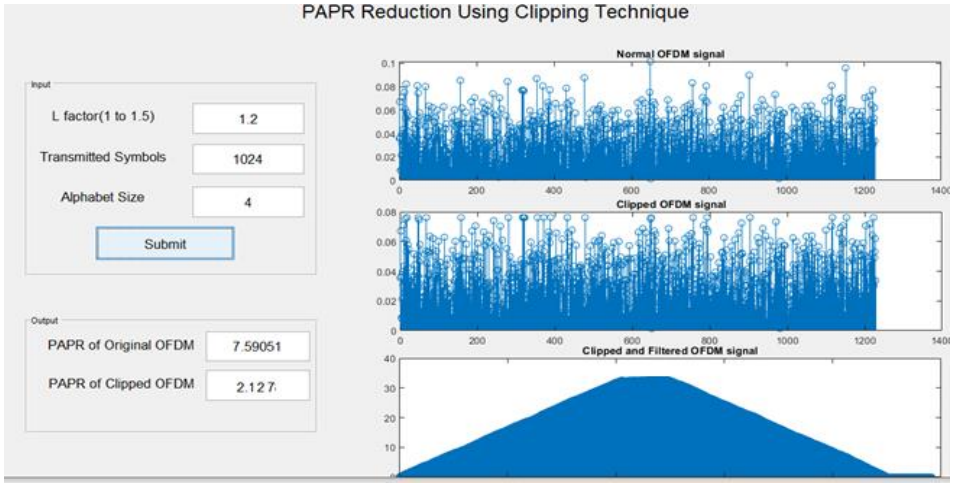

Fig. 3. Case 1: Using 75% Clipping on DWT Based OFDM

Case 2: Using 65% clipping

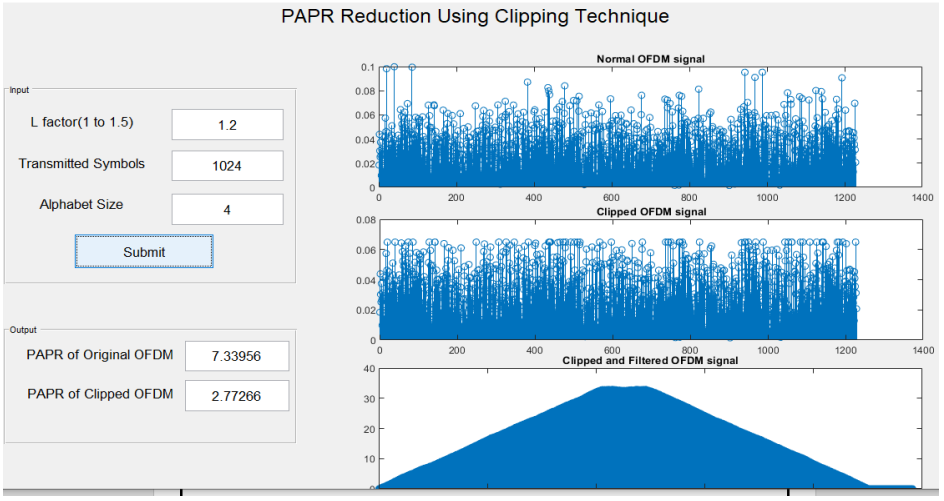

Fig. 4. Case 2: Using 65% Clipping on FFT Based OFDM

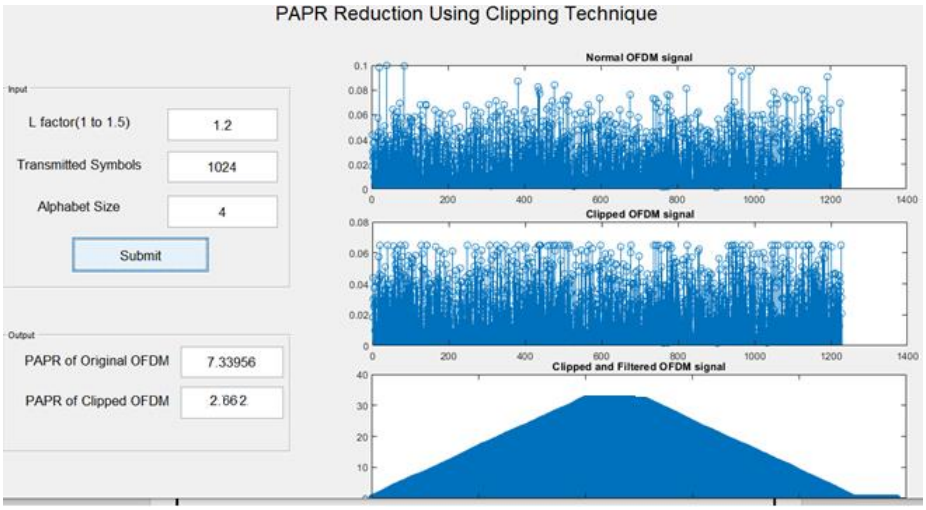

Fig. 5. Case 2: Using 65% Clipping on DWT Based OFDM

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Case 3: Using 55% clipping

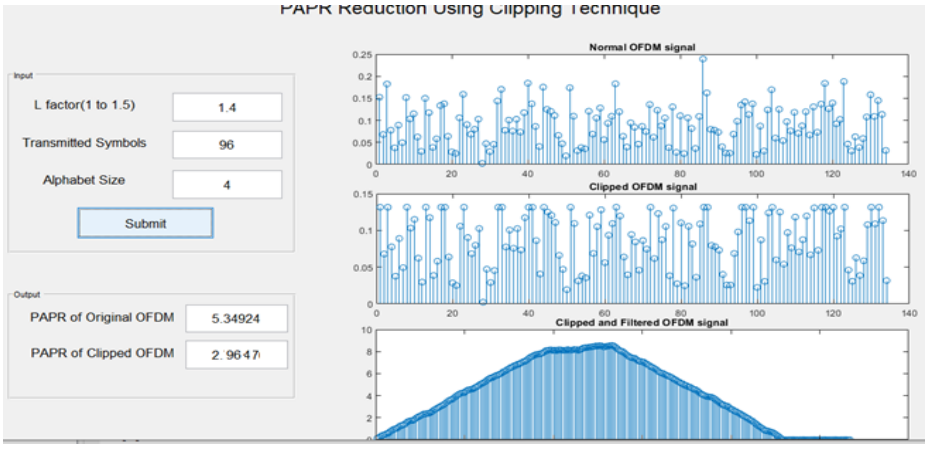

Fig. 6. Case 3: Using 55% Clipping on FFT Based OFDM

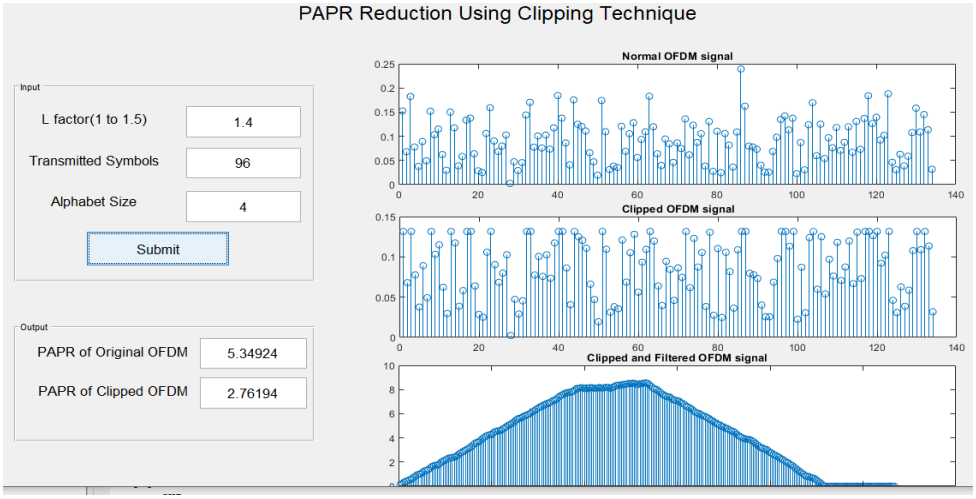

Fig. 7. Case 5: Using 55% Clipping on DWT Based OFDM

V. CONCLUSION

Clipping technique is applied on both FFT and DWT based OFDM systems. Three cases of clipping are taken into consideration for analysis of PAPR. 75% clipping, 65% clipping and 55% clipping are applied on both FFT and DWT based OFDM systems. Clipping technique reduces PAPR for both FFT and DWT based OFDM systems. DWT based OFDM system gives better performance than FFT based OFDM systems in PAPR reduction using clipping technique.

REFERENCES

ISSN: 2233-7853 IJFGCN

[1] Hwang, Taewon and Yang, Chenyang and Wu, Gang and Li, Shaoqian and Li, Geoffrey Ye, "OFDM and its wireless applications: A survey," IEEE transactions on Vehicular Technology, vol. 58, no. 4, pp. 1673- -1694, 2008.

[2] Abdullah, Khaizuran and Hussain, Zahir M and others, "Studies on dwt-ofdm and fft-ofdm systems," in IEEE International Conference on Communication, Computer and Power, 2009, pp. 15--18.

[3] Abdullah, Khaizuran and Hussain, Zahir M, "Simulation of models and BER performances of DWT-OFDM versus FFT-OFDM," Discrete Wavelet Transforms-Algorithms and Applications, 2011.

[4] Naveen, H and Sreerama Reddy, GM, "Performance Analysis of FFT based OFDM and DWT based OFDM for Underwater Acoustic Communication," Indian Journal of Science and Technology, vol. 10, no. 36, 2017.

[5] Hariprasad, N and Sundari, G, "Performance comparison of DWT OFDM and FFT OFDM in presence of CFO and Doppler effect"," 2014 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT) "567—570, 2014, IEEE.

[6] D. Krishna and M. S. Anuradha, "Image Transmission through OFDM System under the Influence of AWGN Channel", IOP Conference, Series: Materials Science and Engineering, vol., 225, no. 1, 2017.

[7] Parveen, Nagma and Abdullah, Khaizuran and Islam, Rafiqul and Boby, Rounakul Islam, "Diversity Technique Using Discrete Wavelet Transform In OFDM System," Int. J. Eng. Adv. Technol., vol. 8, no. 2S2, pp. 284- -287, 2019.

[8] Dr.P.Malathi, Dr.P.T.Vanathi, " Peak to Average Power Ratio (PAPR) Reduction Techniques for OFDM-MIMO System", *IJCSI InternationalJournal of Computer Science Issues, ICVCI-2011,* Vol. 1, Issue 1,November 2011

[9] Prashant Pandey, Rajeev Tripathi, "Performance Analysis of Peak-to-Average Power Ratio (PAPR) Reduction Techniques in an OFDM System", *2012 Third International Conference on Computer andCommunication Technology.*

ISSN: 2233-7853 IJFGCN